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The Engineer

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PUBLIC NOTICES

The Government of the BAHAMAS is prepared to receive TENDERS for the DREDGING of an ENTRANCE CHANNEL and MOORING BASIN in the harbour of Nassau, New Providence, Bahama. Plans, specification and form of Tender may be obtained from the Office of the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W.1, on deposit of Ten Pounds, which will be returned on receipt of a bona fide Tender.

Further inquiries should be addressed to Mr. S. R. E. Beard, Harbour Engineer, Nassau. The approximate net quantities to be removed are estimated at 468,000 cubic yards of limestone and coralline rock and 615,000 cubic yards of sand. The depth to be dredged over the bar is 27ft. at low water and the range of tide does not exceed 4ft. Tenders will be opened in Nassau on July 15th, 1922. 8282

Civil Service Commission.
FORTHCOMING EXAMINATION: INSPECTORS IN THE ENGINEER-IN-CHIEF'S DEPARTMENT of the GENERAL POST OFFICE (17-22), 8th JUNE.

The date specified is the latest on which applications can be received. They must be made on forms to be obtained, with particulars, from the SECRETARY, Civil Service Commission, Burlington-gardens, London, W.1. 8145

Belfast Harbour.

The Belfast Harbour Commissioners are prepared to receive TENDERS for the CONSTRUCTION of a BRIDGE and APPROACHES in TIMBER at Connswater-Pond, on the eastward side of the Musgrave Channel, Co. Down, all in accordance with drawings which may be seen at the office of the Harbour Engineer, Mr. T. S. Gilbert, M. Inst. C.E., from whom copies of the conditions of contract, specification and form of Tender may be obtained.

Tenders must be made on the form provided for the purpose and must be enclosed in a sealed envelope, endorsed "Tender for Construction of Bridge and Approaches," addressed to the General Manager and Secretary, Belfast Harbour Commissioners, and delivered to him not later than Monday, the 12th June, 1922.

The Commissioners do not bind themselves to accept the lowest or any Tender.

M. J. WATKINS,
General Manager and Secretary.

Harbour Office, Belfast,
17th May, 1922. 8260

BY THE AUTHORITY OF THE
Heston and Isleworth Urban District Council, TENDERS are INVITED for the PURCHASE and REMOVAL of a 540 Ampere-hour TUDOR STORAGE BATTERY, consisting of 300 cells.

This plant can be viewed by application to the ENGINEER and MANAGER, Electricity Works, Bridge-road, Hounslow. 8315

State Electricity Commission of VICTORIA.
TENDERS FOR PLANT.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.

Copies of Tender forms and specifications will be available upon application to—
Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.

SPECIFICATION No. 226.
ITEM 1.—5 SURFACE FEED-WATER HEATERS; 2 of 2250 sq. ft. surface, 3 of 1450 sq. ft. surface.
ITEM 2.—6 SURFACE VAPOUR CONDENSERS, each 105 sq. ft. surface.
SPECIFICATION No. 227.
ITEM 1.—12 FEED-WATER EVAPORATORS, preferably of the marine type, supplied with steam at 40 lb. per sq. in., to operate in groups and multiple effect, four effects producing 12,500 lb. per hour.

CHARGE (in each instance).—£2 2s. for the first two copies of Tender form, conditions of contract, specification and drawings complete. These charges will be returned on receipt of a bona fide Tender. A third copy and any further copies will be supplied for the sum of 10s. 6d. each.

PRELIMINARY DEPOSIT.—A preliminary deposit of £50 is to be lodged with Tender in each case.

The specification may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders, on prescribed forms, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 5 p.m. on 1st September, 1922.

R. LIDDELOW,
Secretary.

State Electricity Commission of Victoria.
673, Bourke-street, Melbourne,
Victoria, Australia. 8212

State Electricity Commission of VICTORIA.
TENDERS FOR PLANT.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.

Copies of Tender form and specification will be available upon application to—
Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.

SPECIFICATION NO. 243.—ALUMINIUM STEEL-CORED CABLE AND ACCESSORIES.

CHARGE.—£2 2s. for the first two copies of Tender form, conditions of contract and specification complete. These charges will be returned on receipt of a bona fide Tender. A third copy and any further copies will be supplied for the sum of 10s. 6d. each.

PRELIMINARY DEPOSIT.—A preliminary deposit of £100 is to be lodged with Tender.

The specification may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders may be sent by cable to the Commission, to reach them by Noon, 17th June, 1922. Cable address, "Electrocom, Melbourne." Confirmatory Tenders, on prescribed forms, may be dispatched by the mail following to the undernoted.

R. LIDDELOW,
Secretary.

State Electricity Commission of Victoria.
673, Bourke-street Melbourne,
Victoria, Australia. 8277

PUBLIC NOTICES

Madras and Southern Mahratta RAILWAY COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for :—
(1) 8 LATHES, 84in. centres, Sliding, Surfacing and Screw-cutting.
(2) GIRDER BRIDGES (10 Spans of 60ft.).
(3) 74 TONS GALVANISED CORRUGATED SHEETS (Steel or Iron).

in accordance with the specifications, which may be seen at the offices of the Company. The charge for each specification is One Guinea, which will not be returned.

Tenders must be sent in, addressed to the SECRETARY, not later than 2 p.m. on Tuesday, 20th June, 1922, marked "Tender for Lathes," or as the case may be.

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices,
25, Buckingham Palace-road,
Westminster, S.W. 1,
18th May, 1922. 8270

Metropolitan Water Board.

The Metropolitan Water Board invite TENDERS for the SUPPLY, TESTING, and SETTING to WORK of a STEAM-DRIVEN LOCOMOTIVE SHUNTING JIB CRANE of 4 to 5 tons capacity, at the Battersea Pumping Station (South Lambeth Sidings, G.W. Rly.).

Forms of Tender, conditions of contract, &c., may be obtained on application at the offices of the Board (Room 150), 173, Rosebery-avenue, E.C., by personal application, or upon forwarding a stamped and addressed brief envelope. Tenders, enclosed in sealed envelopes, addressed to "The Clerk of the Board, Metropolitan Water Board, New River Head, 173, Rosebery-avenue, E.C. 1," and endorsed "Tender for Loco. Crane," must be delivered at the offices of the Board not later than 10 a.m. on Friday, 2nd June, 1922.

The Board do not bind themselves to accept the lowest or any Tender.

W. MOON,
Clerk of the Board.

Offices of the Board,
New River Head,
173, Rosebery-avenue,
Clerkenwell, E.C. 1,
16th May, 1922. 8230

TO MANUFACTURERS.

Tenders Invited for Complete MANUFACTURE of High-class New Pattern HYDRAULIC MOTOR VEHICLE JACK in Gun-metal and Steel, work comprising simple machining and small amount of screw cutting (no gear cutting). Jacks to be supplied at irregular and frequent intervals in either small or large batches, strictly to suit sales.

The advertiser does not bind himself to accept the lowest or any Tender.

Drawings and fully detailed and very comprehensive specification sent upon application, accompanied by Tender fee of £1 1s. (not returnable), to Mr. H. GEORGE HARLEY, Consulting and General Engineer, Grand-avenue, Camberley. 8313

The Aden Port Trust Invite TENDERS from Shipbuilders for SUPPLY of a SINGLE-SCREW STEAM TUG to two vessels up to 5000 tons and turn vessels to 20,000 tons register. Form of contract, specification, &c., can be obtained at the office of the Consulting Engineers and Agents on payment of Two Guineas deposit, which will be refunded if a bona fide Tender is received. Sealed Tenders, accompanied by drawings and marked "Tender for Tug," must be lodged with the CONSULTING ENGINEERS and AGENTS, Aden Port Trust, 2, Queen Anne's-gate, Westminster, S.W. 1, not later than Twelve o'clock Noon, Tuesday, 20th June, 1922. The Trustees do not bind themselves to accept the lowest or any Tender. 8279

PUBLIC NOTICES

The Assam-Bengal Railway COMPANY, Limited, is prepared to receive TENDERS for :—
250 IRON COVERED GOODS WAGONS.

Specifications and Tender forms may be obtained at the offices of the Company, Bishopsgate House, 80, Bishopsgate, E.C. 2. A fee of £1 1s. is charged, which cannot under any circumstances be returned.

Drawings may be had at the cost of the tenderer by application to Messrs. Hodges Bennett and Co., Ltd., 78, Queen Victoria-street, E.C. 4.

Tenders must be delivered at the Company's offices not later than Noon on Friday, the 9th June, 1922.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
OSWALD I. MILNE,
Secretary.

20th May, 1922. 8255

The Great Indian Peninsula RAILWAY COMPANY.

The Directors are prepared to receive TENDERS for the SUPPLY of the following STORES, namely :—

	Fee for Specification.
STEEL SCREW COUPLINGS	10s.

Specifications and forms of Tender may be obtained at this office on payment of the fee for the specification, which payment will not be returned.

The fee should accompany any application by post. Cheques and postal orders should be crossed and made payable to the Great Indian Peninsula Railway Company.

Tenders must be delivered in separate envelopes, sealed and addressed to the undersigned, marked "Tender for Screw Couplings," or as the case may be, not later than Eleven o'clock a.m., on Wednesday, 7th June, 1922.

The Directors do not bind themselves to accept the lowest or any Tender.

R. H. WALPOLE,
Secretary.

Company's Offices,
48, Copthall-avenue, E.C. 2,
London, 24th May, 1922. 8305

Barton-upon-Irwell Rural District COUNCIL.
URMSTON AND FLIXTON DISTRICT DRAINAGE JOINT COMMITTEE.

APPLICATIONS are INVITED for the POSITION of SURVEYOR and ENGINEER to the above Authorities.

Combined salary £550, rising by annual increments of £10 to a maximum of £600 per annum. The successful candidate will be required to devote his whole time to the service of the authorities and to carry out all the duties usually appertaining to these offices.

Forms of application (which must be returned not later than the 7th June next) and further particulars may be obtained from the undersigned.

Canvassing in any form, direct or indirect, will disqualify a candidate.

CHARLES FAULKNER,
Clerk.

Council Offices, Patricroft,
18th May, 1922. 8259

The National Foremen's Association of ENGINEERING and ALLIED TRADES hold their FIFTH ANNUAL DELEGATE MEETING on JUNE 3rd, 4th, and 5th, at the VICTORIA STATION HOTEL, NOTTINGHAM. 8295

PUBLIC NOTICES

PATENTS AND DESIGNS ACTS, 1907 AND 1919.
STEAM TURBINES.

The Proprietor of British Patent No. 12,549/13 is PREPARED to SELL the PATENT or to LICENSE British Manufacturers to work under it. It relates to an improved construction of reversing chambers in Stumpf turbines, whereby steam is prevented from passing direct to the exhaust at any position of the rotor.

Address: B. W. & T.,
8297 111 and 112, Hatton-garden, E.C. 1.

PATENTS AND DESIGNS ACTS, 1907 AND 1919.
WIRE STITCHING MACHINES.

The Proprietors of British Patent No. 120,002 are PREPARED to SELL the PATENT or to LICENSE British Manufacturers to work under it. It comprises a work guide provided with guide flaps adapted to engage the part to be stitched together and direct them under the stitcher.

B. W. & T.,
8268 111 and 112, Hatton-garden, E.C. 1.

PATENTS AND DESIGNS ACTS, 1907 AND 1919.
CLUTCHES.

The Proprietors of British Patent No. 26,137/12 are PREPARED to SELL the PATENT or to LICENSE British Manufacturers to work under it. It relates to plate clutches and consists of improved means for disengaging the clutch and for lubricating the rubbing surfaces.

B. W. & T.,
8258 111 and 112, Hatton-garden, E.C. 1.

The Ports and Lighthouses ADMINISTRATION, Egypt, are calling for TENDERS for TWO SINGLE-SCREW STEEL TUGS, Lloyd's highest class. Approximate dimensions :—
Length, 90ft.
Breadth, 17-18ft.
Power, about 500 H.P.

Tenders must be received in London not later than 22nd June.—Further particulars can be obtained from THE INSPECTING ENGINEER,
Egyptian and Sudan Governments,
Queen Anne's Chambers,
Westminster, S.W. 1. 8285

Shanghai Municipal Council.
PUBLIC WORKS DEPARTMENT.
CLERKS OF WORKS.

THREE fully qualified CLERKS of WORKS are REQUIRED in the Public Works Department. Candidates must be about 30 years of age, unmarried, and must be thoroughly competent to supervise the construction of new buildings. Salary, Taels 285 per month without allowances, under a three years' agreement, with a second-class passage from home, half-pay on voyage, and free medical attendance. There is an excellent Superannuation Fund.

The value of the Tael at the present rate of exchange is about 3s. 4d., but it is liable to fluctuation. Taels 285 per mensem at exchange 3s. 4d. are equivalent to £570 per annum.

Particulars of the appointments may be obtained of the Council's Agents, and applications, with full information as to experience, &c., accompanied by copies of three recent testimonials, and endorsed "Clerk of Works," should be forwarded at the earliest possible moment to

JOHN POOK and CO.,
Agents for the Municipal Council of Shanghai,
65, Fenchurch-street,
London, E.C. 3.

May, 1922. 8293

SITUATIONS OPEN

AN Important Old-established Indian Company of ENGINEERS and MERCHANTS, having works in India and offices and go-downs in most of the principal centres in India, invite APPLICATIONS for the POSITION of ACTING MANAGING DIRECTOR.

The appointment can be given only to an energetic man having a thorough knowledge of India and the business conditions prevailing there, and applications giving particulars of experience in a leading position in India are invited.

Applicants should give full information as to busi ness training and career, age and salary required.

Address, 8317, The Engineer Office. 8317 A

ELECTRICIAN.—ASSISTANT ELECTRICAL ENGINEER REQUIRED for India. Single, age 22-30. Experience in Armature Repairs, General A.C. and D.C. Wiring, high and low tension. Must have generating station experience and general knowledge mechanical engineering. Salary, including Provident Fund, Rs. 4500, Rs. 5150, and Rs. 5800 per annum for 1st to 3rd years. Free passage, furnished quarters, and medical attendance provided.—Write, stating age and full particulars, to Z. X. 601, c/o Deacon's, Leadenhall-street, London. 8231 A

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SITUATIONS OPEN (continued)

DROP FORGINGS MANAGER WANTED; a Man of proved ability who can produce stampings at competitive prices. Good wages to sound man.—Address, P5468, The Engineer Office. P5468 A

ELECTRICAL ENGINEER REQUIRED as SHOP MANAGER. Salary £275 per annum plus Civil Service bonus (at present £175 15s. per annum). Candidates should not exceed 32 years of age. They should have had training as Electrical Engineers and experience in the operation and maintenance of Electrical Plant, Lighting and Telephones in large engineering or steel works, and of operating Power Stations, Rotary and Static Sub-stations. Academic qualifications or associate membership of a recognised engineering institution will be a recommendation.—Application, giving full particulars of training and experience, should be addressed to the CHIEF MECHANICAL ENGINEER, Royal Arsenal, Woolwich, S.E. 18, and marked in top left-hand corner of envelope "Electrical Engineer." 8257 A

FIRST-CLASS MANAGER WANTED IMMEDIATELY for large new wet process rotary kiln Cement Plant in India nearing completion. First-class salary will be paid to the right man, preferably one having had varied cement works experience.—MAXTED and KNOTT, Ltd., Consulting and Cement Engineers, Burnett-avenue, High-street, Hull. P5447 A

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TRAVELLERS WANTED, to Solicit Orders for General Engineers and Factory Store Requirements. Unequalled terms offered to those with live connection.—Write, stating full particulars, to Z. X. Y. Z., care Deacon's, Leadenhall-street, E.C. 3. 8320 A

WORKS MANAGER for Engineering Shop; Must be conversant with modern methods in general engineering, including organisation and costs; accustomed to control of men.—Apply by letter, stating full experience and salary required, "Engineer," SIR WILLIAM ARROL and CO., Ltd., 85, Preston-street, Glasgow. 8235 A

WORKS MANAGER for Large Works in Birmingham district. Must have extensive experience in Press Work, both mechanical and hydraulic, produced both hot and cold, for the motor, electrical and engineering trades. Must be good organiser with initiative in modern methods of production. Great energy essential. Exceptional scope for man with ability. Age and experience.—Address, P5452, The Engineer Office. P5452 A

WANTED, Experienced DRAUGHTSMAN for Old-established Firm of Engineers in London; must have special knowledge of Brewery Machinery and capable of taking own particulars, quantities, and estimating. Good position offered to capable progressive man. State previous experience, remuneration required, and when at liberty. Applications treated in confidence.—Address, P5463, The Engineer Office. P5463 A

WANTED IMMEDIATELY, Capable ESTIMATING DRAUGHTSMAN, used to Designing and Preparing Quantities for all classes of Steel Structures. Only men with considerable experience need apply. State age, salary required, and particulars of references.—FRANCIS MORTON and CO., Ltd., Garston, Liverpool. 8264 A

DRAUGHTSMAN REQUIRED by Manchester Firm; used to constructional engineering.—Address, stating age, experience, references, and salary required, 8292, The Engineer Office. 8292 A

DRAUGHTSMAN REQUIRED, North-East Coast. Must be thoroughly competent on all classes of Structural Work and Bridge Work; age 30 to 40. Full particulars, stating salary required.—Address, 8239, The Engineer Office. 8239 A

THE SERVICES of a LEADING DRAUGHTSMAN are REQUIRED in the Locomotive, Carriage and Wagon Department, Highland Railway, Inverness. Salary £350 per annum.

Must have had a good practical training in the Locomotive Department of a British Railway and at least 5 years' drawing-office experience.—Applications, giving age, details of practical and technical qualifications, and other necessary particulars, to be forwarded to the LOCOMOTIVE ENGINEER, Highland Railway, Inverness. 8816 A

WANTED, a First-class FITTER. Accustomed to good work, as a leading hand in a small shop, 30 miles from London. Capable men whom the job would suit are asked to state age, experience, and pay required.—Address, 8293, The Engineer Office. 8293 A

SITUATIONS WANTED

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ENGINEER, A.M.I.M.E., M.I.A.E., &c., with London office, is OPEN to REPRESENT MANUFACTURERS or act as English Agent for continental firms engaged in engineering and allied trades or specialities. Inquiries invited.—Write, WILLIAM A. COPSEY, 4, Devonshire-chambers, 146, Bishopsgate, London, E.C. 2. P5275 B

ENGINEER, Certified, Well Experienced with steam, electrical, hydraulic, refrigerating, gas, oil machinery, and boilers, workshops, steady man, WILLING to TAKE any JOB. Moderate salary if permanent employment. Excellent references.—Address, P5403, The Engineer Office. P5403 B

SINGAPORE.

ENGINEER, Practical, Technical and Commercial experience, A.M.I. Mech. E., M.I. and S.A., going to Singapore, would be GLAD to HEAR of PERMANENCY, S.S. or China. Eight years' experience S.S., for some years works manager to largest firm in Fed. Malay States. Thorough experience, erection and maintenance steam, gas, Diesel engines, boilers, rubber, mining, oil mill machinery. Expert designer, sales experience. Speaks fluent Malay and little Chinese. Age 34. Moderate salary with prospects, any capacity.—Address, P5402, The Engineer Office. P5402 B

ENGINEER SALESMAN, Having Represented a firm of engineers in South Wales for the past three years, DESIRES to make a CHANGE; drawing-office and workshop experience.—Address, P5451, The Engineer Office. P5451 B

ENGINEER, Thoroughly Practical, Combined with theory in steam, oil, gas, mining machinery, office routine, draughtsmanship, &c., late engineer to well-known companies, excellent testimonials, DESIRES APPOINTMENT abroad or home.—Address, P5340, The Engineer Office. P5340 B

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ENGINEER (28) (Faraday House), A.M.I. Mech. E. exam., OFFERS SERVICES as ASSISTANT ENGINEER in return for expenses and the opportunity of salaried employment within a reasonabl period.—Address, P5445, The Engineer Office. P5445 B

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FERRO-CONCRETE.—SPECIALIST ENGINEER, with wide and varied experience in handling designs and construction (bridges, buildings, silos, harbour works, &c.), is OPEN for APPOINTMENT, England or abroad.—Address P5412, The Engineer Office. P5412 B

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GENTLEMAN, with considerable experience in the sprinkler business in all its branches, SEEKS opportunity of MANAGERSHIP for FIRM prepared to start in this line. Can design and prepare drawings for all special valves and has an original idea of his own for special alternate valve. Good combination with heating engineering or tube manufactory.—Address, P5469, The Engineer Office. P5469 D

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MECHANICAL ENGINEER, with Good Practical general experience as foreman, cost clerk and manager, NEEDS responsible POST in any capacity. Moderate salary.—SNOAD, 26, York-road, Hitchin. P5466 B

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FOUNDRY MANAGER, Having Good Personal Connection, £1000 monthly, REQUIRES PARTNER with £1700, to start foundry in Midlands. Guaranteed minimum net profit £900 per annum.—Address, P5467, The Engineer Office. P5467 C

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LONDON.—ENGINEER-AGENT, with First-class offices, show window, stores in Queen Victoria-street, is OPEN to REPRESENT MANUFACTURERS and act as BUYING AGENT for overseas. Good connections; highest references. Compressed air and mining a speciality.—Address, P8261, The Engineer Office. P8261 D

REPRESENTATION.—A Well-known FIRM of ENGINEERS and EXPORTERS with connections in South Africa and offices in Westminster, would be pleased to act as AGENTS for ENGINEERING FIRMS desirous of extending their business.—Address, 8321, The Engineer Office. 8321 D

MISCELLANEOUS

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EDUCATIONAL

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M. I. MECH. E., Engaged on Consulting and Efficiency engineering in London and district, DESIRES PUPIL with sound technical education, not under 21. Good training and commercial practice given.—Address full details, P5414, The Engineer Office. P5414 E

TUITION BY POST.—Inst. C.E. and I. Mech. E. Enrol now for next Exams.; 100 per cent. passes last examination. Reinforced Concrete, new comprehensive course under expert engineer, £3 3s. Write for particulars.—PENNINGTONS, University Tutors, 354, Oxford-road, Manchester. Estab. 1876. Ex.

PATENTS

THE PROPRIETOR of PATENT No. 129,058, for "Improvements in and relating to Scotch Marine Boilers," is DESIROUS of DISPOSING of the PATENT RIGHTS or of NEGOTIATING for the GRANT of LICENCES to work thereunder.—Communications should be addressed to F. W. GOLBY, Patent Agent, late of His Majesty's Patent Office, 3, John-street, Bedford-row, London, W.C. 1. 8062 H

THE PROPRIETORS of PATENT No. 120,855, for "Improvements in and relating to Apparatus for Heating Castings and the like," are DESIROUS of DISPOSING of the PATENT RIGHTS or of NEGOTIATING for the GRANT of LICENCES to work thereunder.—Communications should be addressed to F. W. GOLBY, Patent Agent, late of His Majesty's Patent Office, 3, John-street, Bedford-row, London, W.C. 1. 8093 H

THE PROPRIETOR of BRITISH PATENT No. 156,557, dated June 26, 1915, relating to "Improvements in Machines for Securing Caps or Closures on the Mouths of Bottles or other Containers," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 8187 H

THE PROPRIETOR of PATENT No. 154,239, for "IMPROVEMENTS in BUNDLING MACHINES," is DESIROUS of DISPOSING of the PATENT RIGHTS or of NEGOTIATING for the GRANT of LICENCES to work thereunder.

Communications should be addressed to—
F. W. GOLBY, Patent Agent,
Late of His Majesty's Patent Office,
3, John-street, Bedford-row, London, W.C. 1.
8267 H

THE PROPRIETOR of LETTERS PATENT No. 116,720, relating to "DEVICES FOR INCREASING THE ADHERENCE OF AGRICULTURAL TRACTORS TO THE SOIL," DESIRES to DISPOSE of his PATENT or to GRANT LICENCES to interested parties on reasonable terms with a view to the adequate working of the patent in this country.—Inquiries to be addressed to—
CRUIKSHANK and FAIRWEATHER,
65-66, Chancery-lane, London, W.C. 2. 8271 H

THE PROPRIETOR of BRITISH PATENT No. 13,281/09, dated June 8, 1909, relating to "Automatic Feeding and Cutting Mechanisms for Plastic Material," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to H. SINGER, Steger Building, Chicago, Illinois. 8272 H

TO MANUFACTURERS OF HOT WATER FEED PUMPS AND BOILERS OF LOCOMOTIVES AND OTHER STEAM ENGINES.

THE PROPRIETOR of BRITISH PATENT No. 20,683 of 1914, relating to "IMPROVEMENTS IN HOT WATER FEED PUMPS FOR BOILERS OF LOCOMOTIVE AND OTHER STEAM ENGINES," is DESIROUS of ENTERING into ARRANGEMENTS with Manufacturers or other interested parties for the MANUFACTURE and EXPLOITATION of the invention in the United Kingdom or for the GRANTING of LICENCES thereunder on reasonable terms.

Inquiries in the first instance should be addressed to PHILLIPS and LEIGH, 14/15, Southampton-buildings, 55/56, Chancery-lane, London, W.C. 2. 8280 H

THE PROPRIETORS of BRITISH PATENTS Nos. 150,287 and 154,142, relating to "Breech Action of Automatic Guns" and "Double-barrelled Guns" respectively, are DESIROUS of NEGOTIATING with interested parties for the SALE of the above PATENTS or for the GRANTING of LICENCES on reasonable terms for the manufacture of the patented articles.

Inquiries should be addressed to WM. BROOKES and SON, 55/56, Chancery-lane, London, W.C. 2. P5464 H

THE PROPRIETORS of PATENT No. 188,514, for "Improvements in Means for Regulating the Air Supply Under the Grates of Boiler Furnaces," are DESIROUS of ENTERING into NEGOTIATIONS with a firm or firms in Great Britain for the purpose of EXPLOITING the above invention, either by the SALE of the PATENT RIGHTS or by the GRANTING of LICENCES.

The invention consists in the use of a perforated slide adapted to open or close the air passages in succession.

The invention has been used in France and Belgium to a considerable extent and with great success.

All communications should be addressed to H. N. and W. S. SKERRETT, Patent Agents, 24, Temple-row, Birmingham. P5471 H

FOR SALE

BOILER FOR SALE.

HIGH-CLASS STEEL LANCASHIRE BOILER, 30ft. by 9ft. diameter, by Davy Bros., Sheffield, in 1909; complete with full set of splendid fittings and mountings; re-insure 200 lb. pressure; ready for immediate delivery; low price to clear.—RATCLIFFE and SONS, "The Boiler-House," Hawarden. 8306 G

CROSSLEY Single-cylinder 120 H.P. GAS ENGINE FOR DISPOSAL. Offers invited. Type Z.C.E., speed 162 revs., magneto ignition. In first-class order and may be seen working by appointment.—JOHN and EDWIN WRIGHT, Limited, Universe Rope Works, Birmingham. P5382 G

ENGINE FOR SALE.—300 H.P. Tandem Compound Condensing STEAM ENGINE, by Pollitt and Wigzell, Sowerby Bridge, fitted with Corliss, H.P. cylinder, slide valve, L.P., jet condenser, 16ft. fly-wheel grooved for fifteen 1¼in. ropes. In good order and is being displaced by electric power. Also TWO WEIR PUMPS. Above can be seen by appointment.—SUN FLOUR MILLS COMPANY, Bromley-by-Bow, London, E. 3. 8140 G

FOR SALE

ENGINES FOR SALE.—
1 Horizontal Tandem Condensing ENGINE, by Pollitt and Wigzell, Ltd., 1899, I.H.P. 300, r.p.m. 95, pressure 50 lb.
1 Patent Compound Horizontal Tandem Condensing ENGINE, by Pollitt and Wigzell, Ltd., 1900, I.H.P. 600/800, r.p.m. 70, pressure 150 lb.—JOHN CROSSLEY and SONS, Ltd., Dean Clough Mills, Halifax. P5406 G

FOR IMMEDIATE DISPOSAL, Triple-expansion ENGINE, 10in., 15½in. and 26in. by 18in. stroke, with Marine Type Return-tube BOILER, 10ft. by 10ft., dome, engine and funnel, built to Lloyd's requirements for 160 lb. working pressure; can be purchased cheap owing to cancellation of contract.—Address P5446, The Engineer Office. P5446 G

FOR SALE at Marthes Tydfil:—
500 TONS substantial Second-hand Cast Iron FLOORING PLATES, various sizes, chiefly:—
6ft. by 4ft. by 1in. and 1¼in. thick,
4ft. by 4ft. by 1in. and 1¼in. thick,
4ft. by 2ft. by 7-8in. and 1in. thick.
6 Good Second-hand LANCASHIRE BOILERS, 30ft. by 9ft. 6in., 80 lb. pressure.
4 LANCASHIRE BOILERS, 30ft. by 7ft., 70 lb. pressure.
Also 4 LANCASHIRE BOILERS, 30ft. by 7ft., which have been replaced by larger ones; certified by the Vulcan Boiler and General Insurance Company for 70 lb. pressure. Intending purchasers may view at any time upon application.—Address, P5430, The Engineer Office. P5430 G

FOR SALE, First Quality SECOND-HAND SLEEPERS; main line, unexpected; good for sidings, cart roads, &c.—E. H. NEAL and CO., 59, The Broadway, Ealing, W. 5. Telephone, Ealing 1764. 7931 G

FOR SALE, for Quick Delivery at Low Price, 20 FILTER PRESSES, fitted with wood plates and frames, 30in. square, with all valves and belongings, by S. H. Johnson, Deane, and other makers. Also FOUR Larger FILTER PRESSES, fitted with iron plates and frames, by Johnson.—For further particulars and prices apply, RICHARD SIZER, Ltd., Wilmington, Hull. 8288 G

FOR SALE, High-class GENERATING PLANT comprising 140 K.W. Bellis-Lancashire Dynamo Combined Set, 440 volts D.C.; Three similar Sets, 75 K.W. each; Engines, equal cylinders, suitable 80 lb. pressure. Modern and in practically new condition, for delivery at once.—Address, 8276, The Engineer Office. 8276 G

FOR SALE, ONE Bellis Patent Quick-revolution TRIPLE-EXPANSION ENGINE, 360 B.H.P. with a steam pressure of 180 lb. to 190 lb. per sq. inch, 230 to 400 r.p.m. Full specification on application.—Address, 8159, The Engineer Office. 8159 G

FOR SALE, ONE Practically New 16in. Gardner CRANK PIN TURNING MACHINE; £200.—Address, 8274, The Engineer Office. 8274 G

FOR SALE, ONE 8-Ton Stothert and Pitt LOCO. STEAM CRANE, 30ft. jib, 75 lb. pressure 4ft. 8in. gauge, built in 1917.
ONE 8-Ton and TWO 5-Ton LOCO. STEAM SHUNTING CRANES.
ERNEST E. CORNFORTH, Stoke-on-Trent. 8284 G

FOR SALE, ONE 226 H.P. HELIOS GENERATOR, by Frank Suter and Co., London, 500 volts, 170 K.W., 2, 15 Type, in good working condition. Price £625. Inspection at works.—Apply, E. H. BENTALL and CO., Ltd., Heybridge, Maldon, Essex. P5409 G

FOR SALE, the Largest Stock in the Country of Unused WROUGHT IRON SCREWED and SOCKETED PIPES, both brand new and ex-Army stocks, as follows:—
11,000 Feet, 6in. steam.
100,000 Feet, 6in. water.
125,000 Feet, 4in. water.
47,000 Feet, 3in. water.
15,000 Feet, 3in. water.
12,000 Feet, 5in. steam.
Also 2in., 1¼in., and 1in., 1in., 4in.
10,000 Feet of 6in. Solid-drawn Steel with loose flanges.
GEORGE COHEN SONS and CO., 600, Commercial-road, London, E. 8275 G

FOR SALE, THEODOLITES, DRAWING INSTRUMENTS, SECOND-HAND, CLARKSON'S, 336, High Holborn, W.C. (Opposite Gray's Inn-road).

FOR SALE, LEVELS, DRAWING INSTRUMENTS, SECOND-HAND, CLARKSON'S, 336, High Holborn, W.C. (Opposite Gray's Inn-road). Ex.

FOR SALE.—9 Old STEAM BOILERS, 3 BOILER SHELLS, and 11 TRUSSED ROOF PRINCIPALS, 65ft. span, in good condition.—Details on application to the ENGINEER, Gasworks, St. Helens, Lancs. 8307 G

FOR SALE, 5-Ton Smith LOCO. CRANE, Standard gauge, all motions by steam, wrought iron riveted carriage with wood buffers; £375 on truck Midlands for quick sale.—GEO. COHEN SONS and CO., 600, Commercial-road, E. 14. 8290 G

FOR SALE, 10-Ton ELECTRIC DERRICK CRANE, all steel, jib 135ft., motor 460 volts D.C. Seen in London; makers, Butters Bros.—Apply, KINNEAR MOODIE and CO., Wheatsheaf Wharf, Baliville-road, Hammersmith, London. 8123 G

FOR SALE.—
ONE Practically New Wilkinson 9in. SLOTTING MACHINE, with balanced ram, overhead motion.
ONE Practically New 15in. CRANK SHAPER, by Centaur Tool Co., complete with vice and overhead motion.
ONE New 12½in. CENTRE LATHE, 16ft. 6in. gap bed, S.S.A.S. and S.C., complete with countershaft.
ONE Practically New 7in. Centre LATHE, by Muirs, 12ft. gap bed, hollow mandrill, S.S.A.S. and S.C., overhead motion.
TWO 7in. Centre LATHES, 6ft. 2in. gap bed, S.S.A.S. and S.C. Makers, H. H. Ward.
ONE 36in. VERTICAL DRILLING MACHINE, to drill 12in., automatic and hand feeds, back geared.
TWO WALL RADIAL DRILLING MACHINES, by Rushworth and Co., length of arm from centre to end 6ft. 6in., overhead motion.
ONE New Double-spindle DRILLING MACHINE, drills to centre of 18in., complete with countershaft.
ONE Improved Double-geared RADIAL DRILLING MACHINE, with arm approx. 5ft.
STANLEY ENGINEERING CO., Bath. Ex.

GAS ENGINES FOR SALE:—
84 H.P. Stockport Modern GAS ENGINE.
35 H.P. Tangye, Variable Admission Type.
12 H.P. Latest Type "National" (magneto).
47 H.P. "National" OIL ENGINE, new 1917.
40 H.P. Crossley OIL ENGINE, brand new.
20 H.P. Bellis OIL ENGINE, as new.
7½ H.P. Campbell Electric Type.
HARRY H. GARDAM and CO., Limited, Staines. 8286 G

HIGH-CLASS CARTRIDGE PAPER, Rolls Each of 50 Yards, about 40in. wide, FOR SALE at £2 per roll, delivered free. Discount on quantities.—TACT and CO., Wolves-lane Works, Palmers Green, N. 13, 495 Palmers Green. 8269 G

HORIZONTAL COMPOUND STEAM-DRIVEN AIR COMPRESSORS, 13in. and 22½in. cyls., 27in. wheel in centre, 10ft.; capacity abt. 1000 cub. ft. Would sell engines separately. Been working.—WILLIAMS, 87, Queen Victoria-street, London. 8309 G

For continuation of For Sale Advertisements see page iv.

Chinese Engineering Notes.

(From our own Correspondents.)

In the following notes, one of the special correspondents whom we have recently appointed in China to send us information of value to British engineers discusses the Peking tramway tenders, which are exciting much interest in that city. The financial questions involved are instructive, as they appear to indicate that German influence has been at work. It is well that British engineers should note what severe German competition exists in China, and take the proper steps to meet it. Our correspondent in Shanghai gives some valuable hints about doing business in China, and urges British engineers not actually represented in that country to get into touch with native companies. We may add that our correspondents will be glad to help them in doing so, and that letters on the subject should be addressed to us for transmission. The letter from our correspondent in Hong Kong is devoted to the delightful address presented to the Prince of Wales on the occasion of his visit. It is well worth reading for the sake of its "atmosphere."

Peking.

No decision has been arrived at yet in connection with the Peking tramways tenders. Altogether sixteen firms tendered for the power plant, rolling stock, &c. &c. The tenders were opened on March 20th, and they are being examined by a group of Chinese engineers, who will forward their recommendations to the company in due course. The following firms tendered:—Siemens China Company, Innis and Riddle, British Electrical and Engineering Company, Mitsui Bussan Kaisha, Arnhold Brothers, Jardine Matheson, Anglo-French China Corporation, Compagnia Italiana d'Estrewd Oriente, Chinese Commercial Corporation, Zedelins Westphal and Co., Sintoon Overseas Trading Company, Reiss and Co., Wah Chang Trading Company, Liang Mao Trading Company, and Andersen, Meyer and Co., Limited. Work will be expedited as soon as the recommendations are made known. In considering the tenders, preferential consideration will be given to Chinese firms, after which French companies will have the prior claim. If neither the Chinese nor the French can satisfy the examiners the other firms will be accorded equal treatment.

The Peking Tramways Company is supposed to be entirely Chinese, although there have been persistent rumours that German capital is involved. Originally a concession was given to the Banque Industrielle de Chine, but on the representation of various public bodies, which reminded the Government that tramway undertakings are generally controlled by municipalities, the first agreement was superseded by a second and that agreement whittled down the concession to such an extent that the Banque Industrielle was only given the privilege of appointing certain officials. The capital of the company was given as 4,000,000 dols. (at present rate of exchange about £500,000), half of which was to be subscribed by the Chinese public and half by the Government. Public subscriptions amounted to 800,000 dols., so the first call was for 500,000 dols. from the public and 500,000 dols. from the Government. Although the company does not acknowledge any relationship with the Banque Industrielle the arrangement between the Banque and the Government was that the latter's share of the capital should be furnished out of its credit with the Banque. However, the Banque suspended operations soon after the second agreement was signed and left the Government to find the 500,000 dols. unaided. There was a long delay before the money was forthcoming. Eventually the Ministry of Finance found the Government quota, and as the necessary preliminaries had been completed tenders were called for. It is said that practically all the drawings and specifications were prepared either by Germans or under their guidance, and if this is true it rather confirms the rumour as to German financial participation.

The result of the Chinese Government finding its share of the capital unaided by the Banque Industrielle, seems to have rendered the second agreement null and void. At any rate, that is the opinion of the tramway company's officials, who do not anticipate that Frenchmen will be employed as laid down in the document. On the other hand, it is known that the French Legation here has made strong representations to the Chinese Government, protesting against its cancelling the rights formerly enjoyed by the Banque Industrielle de Chine. There are eleven directors of the tramway company—six elected by the Government and five by the Chinese shareholders. One of the stipulations of the agreement between the Banque and the Government was that the Peking manager of the Banque should have a seat on the Board. That seat has been left vacant since the suspension of the Banque. The remaining ten directors—all Chinese—have met on numerous occasions, but the French Banque representative has never put in an appearance, although nominally he remains a director.

Shanghai.

Although there are no known cases of large industrial plants having been destroyed or hindered in their working, except in so far as transportation facilities are concerned, during political upheavals or civil war in China, the present disturbed political situation does appear to have affected the placing of orders for machinery. The Chinese merchants are uncertain whether they will be able to use the various railways and other means of transportation in bringing their manufactured product to market or, in the beginning, get their machinery to the building they may construct for its use. Another cause for the lull in placing orders is the fact that the native banks find themselves in difficulties, because they were made use of in the supporting of the gambling that has been going on in the various stock exchange companies during the past few months. A large number of these stock exchange companies have closed down, and are not likely to reopen.

Although the Chinese merchants are not actually placing as many orders as usual, large numbers of inquiries for machinery are being made, and as soon as the present political difficulties have been arranged, there should be quite a boom in the engineering line. Forty-two new industrial companies of all kinds were organised in Shanghai during 1921, all of which are native companies, financed and run by natives. British manufacturers not actually represented in this country would do well to get into touch with these native companies, most of which are generally very pleased to receive communications or catalogues direct from Europe or America. The Chinese will generally read a well illustrated catalogue from cover to cover, and if the catalogue is accompanied by letters on the particular industry, it is not difficult to interest him. It must not be supposed, however, that business will result from these methods, but it will give the manufacturer an idea of the requirements of the Chinese, and perhaps in some cases convince him of the necessity of opening up connections in this country.

The directories published in Shanghai and other Treaty Ports give the names of only a few native companies, but such information is generally obtainable from the British Chambers of Commerce in the various ports. The question of language is not such a real difficulty as it was a few years ago, as practically all the native companies dealing in any way with engineering have native engineers on their staffs, who can read and write English. In fact, it may be said that English is the engineering language of China, as the Chinese language does not cover engineering subjects. Practically all the other competing nations explain engineering subjects to the Chinese in English.

Hong Kong.

I am sending you a cutting from the *Peking and Tientsin Times*, which includes a translation of the Chinese address presented to the Prince of Wales when he visited this island. It has nothing to do with engineering, but it breathes with the atmosphere of the East, and it may on that account be of service to your readers as well as of interest to them.

CHINESE ADDRESS TO THE PRINCE OF WALES.

Your Royal Highness, lovingly bearing the Royal token, draws nigh from afar the Princely array.

Long have we looked up to your Royal Highness and now we welcome you as plants the gentle rain.

With one accord we show forth our feeling of gladness and fashion our hymn of praise.

We who have found home and shelter in Hong Kong are enriched by the quickening dew of your favour.

Now that for the first time the Heir Apparent has vouchsafed us the signal honour of his visit, 'tis meet that the streets and lanes resound with song; high and low the people dance with gladness; the willows, that droop their heads along the bank, joyfully brush the Royal Banner; the flowers that fill the earth with flying blossom join in welcome to the Princely Palanquin.

Reverently we admire the surpassing youthful wisdom wherewith nature has endowed Your Royal Highness. All the world looks up to Your pre-eminent virtue.

In the Palace of your Sire, your filial piety has ever been extolled; in your royal studies it was your delight to sit at the feet of learning.

In your heart you have cherished benevolence towards your people and a world-embracing love; in your actions you have displayed kindness to all men and a wide humanity.

Millions have enjoyed the fruits of your unselfish labour: the whole world has tasted the delights of your Royal condescension.

You reverence civil rule, and esteem martial glory.

You are well versed in the arts of war by sea and deeply skilled in the strategy of battle by land.

In the year 1914 when Great Britain raised her righteous army, and the titanic struggle began, Your Royal Highness entered in person the ranks of war and yourself donned the cuirass and the helm.

You comforted your soldiers and shared their joys and hardships.

You were present at your post and shirked not pain or danger.

Till at the last you prevailed to sound the clarion of victory in the field, and to raise the pæan of triumph o'er the vanquished.

Verily your merit o'ershadows the age, and your fame covers the world.

Scarce were the weapons of warfare sheathed ere you received the Royal Envoy's staff.

You bore your floating banner to the lands that own your sway, and the enrolled nations felt their loyalty grow yet deeper.

You went with gifts of polished jade to the countries that hold your friendship, and the glad bond of sworn faith was drawn yet closer.

And now once more you have driven forth from the Royal City, and stayed your steeds in the Fragrant Isle.

Her thickly clustered dwellings are blessed as by the beneficence of bright rain.

Her plants and trees and other living things are touched as by the virtue of creative spring.

Withersoever your radiance reaches, songs of praise rise with one accord; in the rhythmical movement of hands and feet, we show forth our sincerity of heart.

Brighter the Sun, rounder the Moon,—Your Royal Highness, reacheth to a fuller power. We pray for unbounded blessings on Your Royal Highness, that we, the people, may receive never-failing peace.

Reverently with folded hands and bowed heads we offer our hymn of praise:—

Hail, Imperial England, thy might hath no peer
Within the realms that Ocean circles.
Great is thy call, Oh Heir to the Throne;
Thy ways are a pattern to all the World
Through the charm of thy person, thou makest known
Thy Sire's virtue to distant lands.
At the altar of covenant, thou hast thy place.
To this islet set in a magic sea,
'Tis vouchsafed to welcome the Phœnix banner.
The heavens reveal a smiling face
And earth resounds with shouts of gladness.
May abundant blessing be showered down, and happiness descend upon all living things.
With uplifted faces we acknowledge thy sheltering care,
We are clothed with honour that shall not pass away.

The Grampian Hydro-Electric Scheme.

THERE is at present before Parliament a Bill seeking powers to develop an extensive hydro-electric scheme in the Grampian Mountains. The total watershed area involved is some 418 square miles, the majority of it lying in the north of Perthshire, and the remainder in the south of Inverness-shire. The project is but the commencement of a much larger scheme which is intended to embrace the whole of the valley of the Tay, but, for all that, it is not in itself small, seeing that it is proposed to install plant of sufficient capacity to generate 56,000 horse-power continuously when all the four power-houses which are provided for have been got to work. As we write, the Bill has been passed by a Committee of the House of Commons for third reading.* It may be taken as fairly certain, therefore, that the undertaking will be carried out practically in accordance with the following description.

The key of the scheme is Loch Ericht, which is a narrow body of water some 16 miles long and varying in width from a few hundred yards to nearly a mile. It is almost straight in plan and it lies in a line which is approximately from S.W. to N.E. At the present time its natural outlet is by means of the river Ericht, which flows out at its southernmost point and after a steep descent for something over 5 miles falls into Loch Rannoch, another considerable body of water about 9½ miles long, with an average width of rather over ½ mile. From the nature and configuration of the ground at the north-eastern extremity of the loch it would seem to be not improbable that, in times long gone by, the outlet from Loch Ericht was at that end, if, indeed, there were not two outlets, one at one end and one at the other. At any rate, in order to raise the level of the loch, as is intended, it will be necessary to build two dams, one at one end and the other at the other. The present top-water level of Loch Ericht is at 1153ft. above Ordnance Datum. By means of the dams it will be possible to raise the level first to + 1170 Ordnance Datum and then to + 1190 Ordnance Datum, and by the aid of a channel cut at the south-western end, it is to be possible to draw water from the reservoir until the level is reduced to + 1132 Ordnance Datum. The storage capacity made available by this means amounts to no less than 80,000,000,000 gallons. It may be explained that the loch is admirably suited for the purposes of a reservoir, since its sides rise very steeply and its outlets are constricted. The dam at the north-eastern end is to be 35ft. high, and that at the south-western end 50ft. high.

Loch Rannoch, when the alterations which it is proposed to effect are carried out, will have an available storage capacity of some 10,000,000,000 million gallons. The necessary works are not nearly so heavy as those required for Loch Ericht, and will consist of a

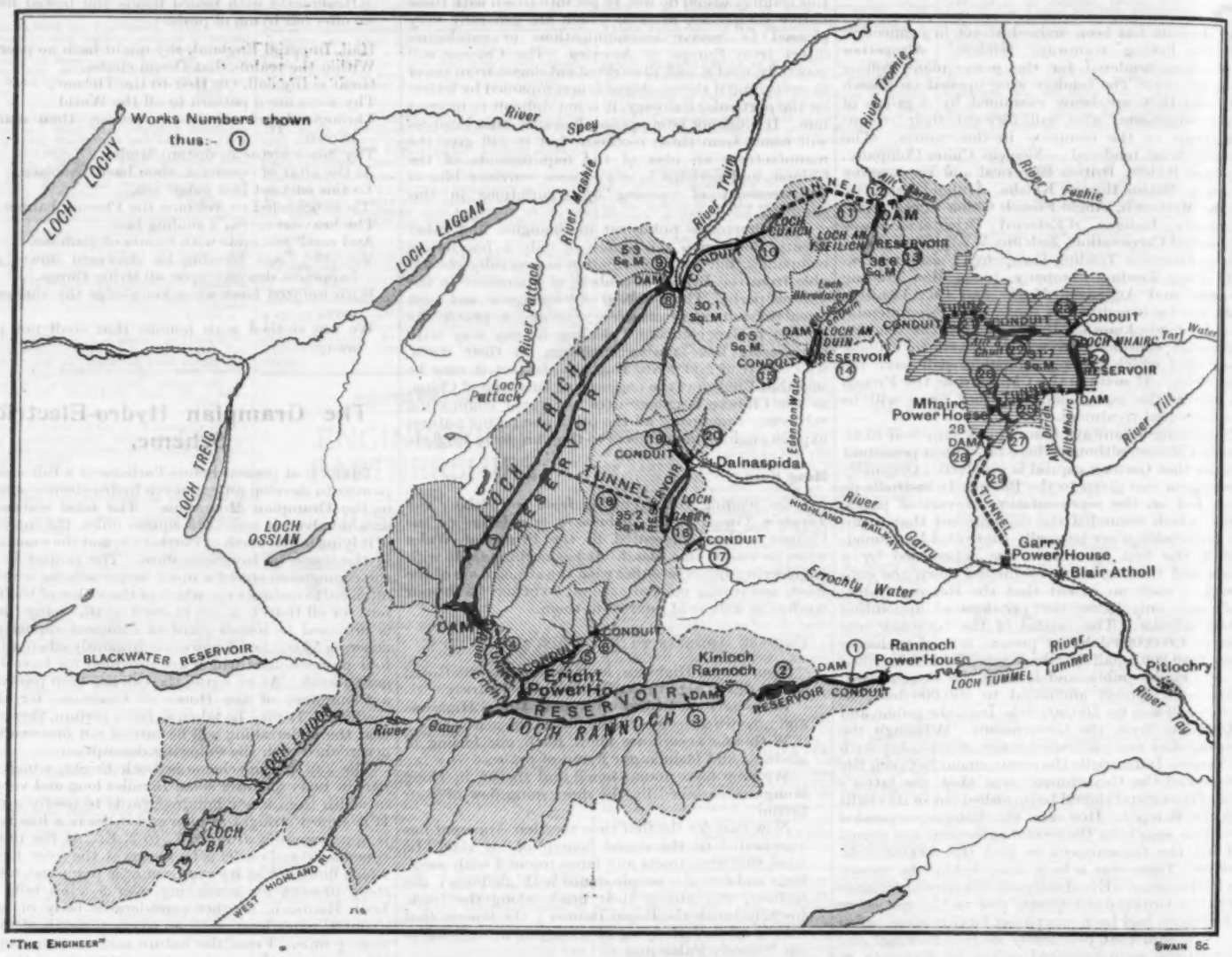
*The Bill was considered on report on Tuesday last in the House of Commons and was passed by a majority of 107.

comparatively small regulating dam by means of which the level of the water can either be raised or lowered 4ft. above or below the existing level of + 668 Ordnance Datum. Five miles or so down stream from the eastern or outlet end of the loch it is proposed to construct a dam which will have the effect of creating an artificial reservoir on the river Tummel, which reservoir is to have a top-water level of + 650 Ordnance Datum, and a storage capacity of 450,000,000 gallons.

We are now in a position, with the aid of the accompanying map, to explain the plan of procedure which it is proposed to follow. The scheme has been divided into two stages. Stage I. includes the building of two power-houses, the one operated by the flow of water from Loch Ericht to Loch Rannoch, and the other obtaining its supply of water from the artificial Tummel reservoir by means of the conduit marked 1 on the map. We may here explain that the various numbers contained in circles on the map indicate the different works referred to in the Bill, and are not intended to show the order in which those works will necessarily be carried out. Scheme I. also includes the construction of a pressure tunnel—Work 4—to lead the water to the Ericht power-house, and the Ericht catchment area, thus raising it to 104.9 square miles. We may here remark that, as in the case of the Spey Fishery Board, agreement has been arrived at between the promotors of the scheme and the Tay District Fishery Board, by which such a flow of water would be maintained down the river Tummel, as would preserve the fishery interests, and that arrangements have been made to give the river Tay the benefit of the Lammas floods, and to allow of the free passage of fish at all times.

The available head at the upper, or Ericht, power-house is 450ft., and it is intended that the electrical plant installed in it shall be capable of generating 16,000 brake horse-power continuously. The catchment area of the rivers Gaur and Tummel above the lower or Rannoch power-house is 200.8 acres, but the available head is only 150ft. It is proposed, therefore, that the continuous capacity of that power-house shall ordinarily be only 14,000 brake horse-power. Sufficient machinery will, however, be installed to develop double that quantity or 28,000 brake horse-power, the idea being that in times of flood, or of plentiful rainfall the lower, or Rannoch, power-house shall operate at double its ordinary capacity or to a maximum of 28,000 brake horse-sion of the upper stretches of the Bhran and Edendon Water into one or other of the reservoirs. The Bhran diversion will need not only a weir on the river, but a tunnel 8ft. in diameter and nearly a mile long. The Garry-Ericht tunnel—Work No. 18—will measure 6ft. in diameter, and will be some 4¾ miles long, while the Seilich-Cuaich tunnel, which will measure 9ft. in diameter, will be nearly 3 miles long. These additions will have the effect of increasing the area of the Loch Ericht gathering ground by 35.2, 6.5, and 38.6 square miles, bringing it up to a total of 185.2 square miles. As a consequence, the continuous output of the Ericht power-house will be increased from 16,000 to 26,900 brake horse-power, and that of the Rannoch power-house from 14,000 to 17,400 brake horse-power.

Stage II. also contemplates the taking in of an entirely separate gathering ground known as the Mhairc, from a loch of that name which is within it. Its position will be seen in the accompanying map, and it will be observed that the area within the watershed is 31.7 square miles. In this case again, there will be two power-houses, and the whole of the water passing through the upper will also pass through the lower, the latter also reaping the benefit of any flow in Bruar water which remains undiverted. The works proposed



"THE ENGINEER" SWAIN Sc.

MAP ILLUSTRATING THE GRAMPIAN HYDRO-ELECTRIC SCHEME

artificial increase of the catchment area of Loch Ericht in the following manner: The area inside the Loch Ericht watershed is at present 52.6 square miles, which is small for such a large water surface. By means (*a*) of Work 8, which includes the construction of a dam on the upper part of the river Truim and of a conduit delivering the water so obtained into Loch Ericht; (*b*) of Work 9, which involves the construction of a dam on the river Sluic, and a further conduit leading to the reservoir, and (*c*) of a conduit connecting Loch Cuaich with Loch Ericht, tapping the upper waters of the streams Choire Chais and Choire Chaim on the way, the drainage area will be increased by 30.1 and 5.3 square miles respectively, so that the total drainage area will become 88 square miles. All these streams are tributaries of the Spey, and we understand that satisfactory arrangements have been made with the Spey Fisheries Board as to the amount of water that may be abstracted from them. Furthermore, the drainage area is to be increased by the carrying out of Works 5 and 6, by which the upper waters of the Killichonan Burn and the Aulich Burn are diverted into the conduit leading from Loch Ericht to the power-house. As these streams are tapped at a higher level than + 1190 Ordnance Datum, the effect is to add to a further 16.9 square miles to power and that, at the same time, the output of the upper, or Ericht, power-house, shall be reduced from 16,000 brake horse-power to 2000 brake horse-power. The object of this arrangement is to conserve the flood water entering Loch Ericht to the greatest possible extent so as to build up a reserve of water for use in case of need. It will be realised, of course, that the water operating the Ericht power-house will also eventually help to operate the Tummel power-house. By drawing down Loch Rannoch to its full extent just before the flood periods of late autumn and winter, as it is proposed to do, it will be possible still further to build up the reserve in Loch Ericht.

Stage II. consists, first of all, in still further artificially increasing the area draining into Loch Ericht, the work being divided into two portions. One portion includes the driving of a tunnel to connect Loch Garry with Loch Ericht, and the diversion into the former of the upper waters of various neighbouring streams. The second portion embraces the raising of the level of Loch An Duin, by a dam at its north end, the increasing of the length of Loch An T-Seilich, which stands at + 1395 Ordnance Datum, by the building of a dam on the river Tromie about a mile down-stream; the driving of a tunnel to connect Loch An T-Seilich with Loch Cuaich; and the diver-consist of the increasing of the size and elevation of Loch Mhairc; the diverting of the upper tributaries of Bruar water, and of Tarf water into the loch by means of conduits and of a tunnel about two miles long; and the driving of a tunnel 6ft. in diameter from the loch to the Mhairc power-house, the tunnel picking up several other tributaries of Bruar water on the way. The discharge from the power-house will be into Bruar water, and something over a mile lower down the stream there is to be a dam from which a tunnel 7ft. in diameter and nearly five miles in length—Work No. 29—will lead to the Garry power-station on the banks of the river Garry. The Mhairc power-house is to develop 4200 brake horse-power, and the Garry power-house 7500 brake horse-power, both of them continuously. Of course, if power is supplied for shorter periods than twenty-four hours in the day, the powers just mentioned will be increased proportionally, and the same remark applies to the figures given for the Ericht and Rannoch power-houses.

The available head at the Mhairc power-house is to be 650ft. and at the Garry power-house 870ft. For the higher heads throughout the scheme the present proposal is to use turbines of the Pelton wheel type, and for the lower heads re-action turbines of the Francis type. At the Ericht power-house units of

10,000 kilowatts capacity may be employed, but at the other stations the units will not, probably, be larger than 5000 kilowatts. Three-phase current will be generated at a pressure of 6600 volts, and for transmission purposes a pressure of 100,000 volts is to be used and overhead conductors employed. We may say that both Glasgow and Dundee come within the area throughout which it is proposed to supply energy, the length of transmission line in each case being about 70 miles.

It will have been understood from the foregoing that, when the scheme is carried out in its entirety, a total of 56,000 continuous brake horse-power, as set out in the following table, will have been made available :—

Ericht power-house	26,900
Rannoch power-house	17,400
Mhaire power-house	4,200
Garry power-house	7,500
	56,000

The promoters of the scheme are the Hydro-Electric Development Company, backed by a strong financial group, and the engineering details have been worked out by Messrs. Mott, Hay and Anderson, of Westminster, in conjunction with Signor Angelo Omodeo, who has carried out a very large amount of hydro-electric work in Italy. We are indebted to the former for the particulars from which the foregoing has been prepared and for the drawing from which our illustration has been reproduced.

The Indian Railway Administration Report.

In the Indian Railway Administration report for the year ended March 31st, 1921, which lies before us, a short introductory chapter gives a brief review of the outstanding facts of the trade, agricultural and shipping position on which railway working in that country so greatly depends, and it is hoped that the facts therein exhibited will be of assistance to the student of railway working in assigning a true value to the results attained.

Review of Trade Position.

India has hitherto been primarily an exporting country with a consequent favourable balance of trade. The outstanding feature of 1920–21 was the reversal of that position, consequent on an enormous increase in the value of imports, coupled with a serious decline in exports. The gross imports of private merchandise reached, in value, the record figure of 336 crores of rupees,* which represents an increase of no less than 61 per cent. over the preceding year. The exports of private merchandise, including re-exports, on the other hand, amounted to 256 crores, a reduction of 22 per cent. The most noticeable features of the import trade of the year were (*a*) a large increase in manufactured goods, particularly cotton piece goods, iron and steel, machinery and mill work, railway plant and rolling-stock, cotton twist and yarn, motor cars and motor cycles, hardware and woollen piece goods ; (*b*) a decrease in sugar and, to a small extent, in petroleum oil and silk piece goods.

Lines Open, Under Construction and Projected.

During the year 298 miles of railway were added, bringing the total of open mileage up to 37,029. Particulars are given of the mileage opened during each of the fifteen vice-royalties since "the first modest opening in 1853, represented by the little surburban line from Bombay to Thana, 21 miles in length, laid with light iron rails and equipped with three small engines and a dozen primitive carriages." The 37,029 miles were composed of 33,985 miles of single track, 2948 miles of double and 96 miles of from three to six tracks. Of broad gauge there were 18,195 miles ; metre gauge 15,248 miles ; 2ft. 6in. gauge 2948, and 2ft. gauge 638 miles. The mileage of Government owned railways was 26,889, and of those owned by Indian States 4394, whilst private companies owned 5746 miles. The report observes : "The principle of Government-owned railways being leased to companies to work is almost peculiar to India, and the ultimate wisdom of this policy has, in recent years, been the subject of very keen controversy." The actual mileage worked by the different agencies was :—Worked by the Government, 8929 ; worked by Indian States, 2889 ; worked by companies, 25,211.

Of the 298 miles of new line opened during the year 189.5 belong to the Dalbandin-Mirjawa section of the Nushki Extension Railway, broad gauge, in Baluchistan built for military purposes. Among the railways under construction is the Khyber Railway, a frontier line designed to meet military requirements, 26 miles long, and expected to cost nearly two crores of rupees, and the Balharshah–Warangal, 150 miles in length, financed by the Nizam of Hyderabad, which will afford an important link between the broad gauge railways in the north and south of India.

Capital Expenditure.

The capital expenditure of the year was 24,08 lakhs, made up of 12,91 lakhs on works, 10,15 lakhs on rolling-stock and 1,02 lakhs on new lines.

Quadrupling of lines is being extended in the suburban areas of Bombay and Calcutta which, when completed, will afford very great relief in respect of the housing difficulties in those cities, and will facilitate greatly the work of dealing with the heavy traffic flowing towards, and originating from, the two largest trade centres of the Empire. During the year the remodelling of forty-one station yards was in hand. Five of these works are named and it is stated that the aggregate cost of them will be Rs. 2,37,89,649.

Apart from extension of yards, provision for increased traffic involves larger station accommodation, more crossing stations, better water supply, and quarters for the staff. The last item, it is observed, is now a very serious question on nearly all lines. The public has had unfortunate evidence of the discontent prevailing on some administrations, and this question of quarters is a matter of very great importance, as it is impossible to expect a contented staff if it is not decently housed. Every effort has, therefore, been made to improve matters in this direction, and the expenditure on this item alone during the year was in the neighbourhood of 150 lakhs of rupees.

So far only the fringe of the subject of necessary capital works has been touched. The administration of nearly every railway in India has represented the necessity of extended repair facilities in shops, for larger yards, stations, &c. Some of these projects are :—(1) Remodelling Victoria terminus, Bombay, G.I.P., 47 lakhs ; (2) Grant-road terminal station, B.B. and C.I., 16 lakhs ; (3) Grant-road–Bandra quadrupling, 34 lakhs ; (4) remodelling Margaon station yard, 36 lakhs ; (5) electrification of the Bombay suburban sections of the B.B and C.I. and G.I.P. railways, 376 lakhs ; (6) remodelling of Lucknow station yard, 16 lakhs ; (7) improvements to traffic yard and extensions of workshops at Allahabad station, East Indian Railway, 46 lakhs ; (8) new workshops at Drig-road station, near Karachi, North-Western Railway, 336 lakhs ; (9) new shops at Dohad, B.B. and C.I., 200 lakhs. In addition to these projects the Bengal–Nagpur Railway has drawn up a scheme for the improvement of traffic facilities which is estimated to cost about 2½ crores of rupees. These works are required with a view to afford transport facilities for the carriage of the large traffic expected from the steel industry.

Rolling Stock.

An indication of the want of repair facilities may be gathered from the fact that the number of coaching vehicles shown in Appendix 17, as undergoing or awaiting repair, has increased on most lines. The want of traffic facilities, combined with the deterioration of the track, has led to a fall in the average speed of both passenger and goods trains on many lines. Similar indication is found in an increase of empty running, and a decrease of loaded mileage. It is obvious, therefore, says the report, that the reasons giving rise to this tendency to uneconomical working will have to be dealt with concurrently with the question of wagon supply. A further increase of wagons in existing circumstances would simply accentuate this evil and would, in a large measure, fail to give the desired relief.

During the year there were added 375 engines, 208 coaching vehicles and 6493 wagons, and at the end of the year there were 9365 engines, 24,951 coaching vehicles and 201,194 wagons. The broad gauge lines had 6148 engines, 13,591 carriages and 139,178 wagons ; the metre gauge 2723 engines, 9469 carriages and 55,639 wagons ; the 2ft. 6in. and 2ft. gauge lines had 494 engines, 1891 carriages and 6377 wagons.

For war purposes overseas Indian railways gave up 237 engines, 493 coaching vehicles and 5502 wagons, which represented a direct loss additional to the ordinary decreases due to wear and tear. Despite this fact there were on March 31st, 1921, as compared with six years earlier, 972 more engines, 1980 more carriages and 17,118 more wagons. "It is, therefore, evident that railways have certainly not stood still in this matter of supply and, to the extent to which the complaints of the public are justified, they indicate that the needs have increased faster than the stock, combined with the capacity to handle."

On the question of the existing means of supply it is remarked that India is, so far, incapable of making engines at all. The capacity of the existing private wagon constructing shops is very limited and, even so, the output is dependent upon supply of wheels, axles, brake gear, &c., from England and abroad. Coaching stock is mostly erected in railway shops, but this work is dependent on supply of all the main parts and fittings from England. The uncertainties of English supplies and the constant failure, from one cause and another, since the war is a matter of common knowledge. For these reasons no railway in India was able to work up to even the programme of output for which funds had been provided.

Working Expenses.

During the year 1920–21, the ratio of working expenses to receipts was 65.54 as against 56.81 during the year before. In 1911 it was 52.17, in 1912 48.92, in 1913–14 51.79, and in 1914–15 54.19. It is probable that the high-water mark was not reached and that 1921–22 will show an even higher proportion. Of the expenditure of over 60 crores 82 per cent. was consumed by the engineering department ; 34.62 by the locomotive—which includes running expenses—12.12 per cent. by the carriage and wagon and 17.60 per cent. by the traffic.

The report says that the 19.82 per cent. for the maintenance of way "is certainly unduly high, but this is due to special repairs and renewals which have become necessary as a result of neglect during the war. The result of arrears in this respect is evident in slower timing of trains, speed restrictions, especially over bridges, &c., all of which militate against satisfactory working. It is probable, therefore, that no economy in this direction will be possible for at least three or four years." It is then explained that the railway policy hitherto adopted does not allow for sums to be set aside annually for depreciation.

Fuel has, in recent years, become a matter of considerable anxiety owing to the rise in the price and actual shortage of supply. There were 63,828 tons of oil fuel used, but the practice of oil firing is still in its infancy. The experiments hitherto made have, however, proved to be successful, and steps are being taken to make use of oil as fuel on engines on an extensive scale. Arrangements have been made for the supply of nearly a quarter of a million tons of oil fuel annually, which will be used by the North-Western and the G.I.P. companies. The latter company had converted for oil fuel at the end of the year about forty locomotives, and had in hand the erection of thirty new powerful engines suitable for the use of oil fuel. As was mentioned in the report for 1919–20, the North-Western Railway has converted 129 engines for use of oil and made provision for a corresponding storage of fuel.

Earnings.

The gross earnings for the year were 92 crores. During the last ten years they have increased by 79.86 per cent. In 1911 the tonnage was 71,268,000 and the number of passengers 389,863,000 ; in 1920–21 these figures were 87,542,000 tons and 559,246,000. In the last twenty years the gross earnings have rather more than doubled, while passengers have almost trebled, and earnings from them nearly quadrupled. The conclusion, therefore, which follows from this analysis is that the passenger traffic is definitely increasing faster than the goods, which, besides being an important testimony to the increased prosperity of the people, is a fact of very great importance in respect of railway policy. It is perhaps not generally known that when railways were first started in India the opinion was confidently expressed that very little provision for passenger traffic would be required, since caste difficulties would prevent the railways from being generally used by the people.

As was to be expected, the third class considerably out-numbers all the rest put together ; but there are some interesting facts in respect of the higher classes. In the year 1916–17 the number of passengers travelling by intermediate class was 14,348,800, but in 1920–21 the number had fallen to 11,749,600. The corresponding figures of first and second classes show clearly that this result was due to the better class Indian having transferred his patronage to the higher classes as providing greater comfort and privacy.

In any consideration of earnings we would have it remembered that passenger fares on small lines have been increased to a very small extent, and that nothing in the way of a general increase in goods rates has been made. The report says that India is alone among all the nations of the world in having escaped so far a general and extensive rise in railway rates.

* A lakh is 100,000 rupees—written 1,00,000 ; a crore is 100 lakhs—written 1,00,00,000. The standard rate of exchange is Rs. 10 to the £1 sterling ; present rate 1 rupee = 1s. 3¼d.

INCREASING TRAFFIC ON FRENCH ROADWAYS.

The Minister of Public Works, in his 1923 Budget proposals, describes how much requires to be done to put the main roadways of France into good order. It is pointed out that it is not only in England that the heavier traffic is making the upkeep of roads a difficult and costly matter ; France is faced with the same problem. According to statistics for 1913, the motor vehicles in France did not then exceed 100,000, of which only 8000 were motor lorries. At the beginning of 1921 the total number of motor vehicles alone amounted to 208,000, of which 93,000 were motor lorries. This fact in itself, it is urged, is enough to account for the additional wear and tear to the roads, but greater speed and increased tonnage also have their share in demolishing the roadways. On an average, a motor vehicle covers from five to six times the distance traversed per day by a vehicle drawn by animal traction.

Since the Armistice, if account be taken of the rise in the price of labour and materials since 1914, the annual credits assigned to the repair of roadways do not exceed the amounts provided before the war. A comparison is made between the pre-war expenditure on roads in England, which, it is stated, amounted roughly to 2000f. to 2500f. per kilometre for high roads, and the French pre-war credit of 1000f. per kilometre for "national routes," corresponding to the English main roads. The United States Budget of 1918 provided 286 million dollars for the construction of 19,000 kiloms. of new roads. It is estimated that the whole of the French roads amount to about 45,000 kiloms. (say, 28,000 miles), excluding minor country roads which require little attention.

In addition to the extra work entailed by increased and heavier traffic, the many miles of roadway destroyed during the war have had to be restored, a task of no small difficulty, since the roads were everywhere pitted with shell craters several feet deep and were torn up by the passage of heavy artillery. The first hurried repairs were largely carried out by the simple means of carting the powdered brick and stones from the ruined villages on to the roads. More permanent restoration has now been effected, and in many parts of the devastated regions the roads are as good as they were before the war. The roads leading up to the front also suffered considerably by reason of the unusually heavy traffic during the war ; repairs to them also have been carried out. The special tracks for cyclists, which run by the side of many of the main roads in France, are badly in need of attention.

THE INSTITUTION OF MINING ENGINEERS.

The seventy-seventh general meeting of the Institution of Mining Engineers will be held at Sheffield, by invitation of the President and Council of the Midland Institute of Mining, Civil and Mechanical Engineers, on Tuesday, Wednesday, and Thursday, June 20th, 21st, and 22nd, 1922, at the Cutler's Hall, by permission of the Master Cutler.

Arrangements are being made for visiting works, research laboratories and collieries—including sinkings where cementation is in progress—in the afternoons of Tuesday and Wednesday, and on Thursday. The social arrangements will probably include a dinner on Tuesday evening and a reception and dance on Wednesday evening.

It is expected that the following papers will be read or taken as read, and submitted for discussion :—(1) "The Air-cooling Plant at the Morro Velho Mine, Brazil," by Eric Davies (member) ; (2) "Stainless Steels," by W. H. Hatfield (read before the Midland Institute meeting on April 8th, 1922) ; (3) "Methods of Working the Barnsley Seam of the South Yorkshire Coalfield," by H. Rhodes (member), and M. Rhodes (member) ; (4) "Rock Temperatures in the Coal Measures," by J. Ivon Graham (associate member) ; (5) "The Absorption of Carbon Monoxide by the Blood under Varying Conditions of Work," by Alfred P. Veale (member).

Developments in Power Station Design.

No. XXXI.*

THE manufacture of condensing plant was first taken up at the Willans and Robinson works of the English Electric Company in 1903, and since that time many condensers have been built at this factory for use in conjunction with the company's turbines and those built by other firms. Many important improvements have been made in the design of these condensers. To obtain a high degree of vacuum in the exhaust it is essential that the frictional resistance of the steam across the tubes should be reduced to the lowest value possible, and for that reason the path of the steam must be direct into the condenser, and the steam must spread itself over a large initial surface of the tubes. The banks of tubes should, moreover, be as shallow as possible. For these reasons, the so-called boat-shaped condenser has been developed by some makers, but whilst this type possesses advantages, it requires internal stays, which interfere with the flow of steam, and it is also considered to be expensive to construct. The English Electric Company has therefore adhered to the circular type of condenser, because it is considered to retain the advantages of the boat-shaped design without possessing its disadvantages. The steam enters and distributes itself over a very large tube area which extends between the tube plates, thus avoiding dead pockets where condensation is not effective. At the same time the diameter of the bank of tubes through which the steam has to pass does not exceed half the diameter of the condenser. Condensers built on these lines, the makers point out, are exceedingly simple. There are no internal stays, and nothing to obstruct the direct flow of steam on to the tubes. The design also enables a plain casing to be used without ribs.

When the steam enters the condenser, the volume of air is exceedingly small as compared with the volume of steam, but as the steam is condensed the volume of air increases until at the bottom of the condenser it reaches an appreciable amount. Experiments have shown that a small quantity of stagnant air around the tubes materially reduces the rate of heat transmission. This, however, does not occur in practice, because in a properly designed condenser there is no stagnant air, and with a reasonably large air pump there is no risk of a reduction in heat transmission arising from that cause. It is very necessary to ensure that the air is withdrawn from the condenser, so that it is swept straight across the tubes, and that no air pockets are formed. A method of obtaining the desired results is shown in Fig. 178, where the air branches are taken from the sides of the condenser, and they communicate with spaces inside plates that extend the whole length of the body.

There is no direct method of measuring the amount of air entering a condenser, but makers have arrived at suitable allowances by experience. Generally, from 3 lb. to 6 lb. of air per 10,000 lb. of steam are allowed, the latter figure being for 3000-kilowatt sets and the former for 20,000-kilowatt sets. The method of basing the air allowance on the quantity of steam is very unsatisfactory, because only a very small amount of the air to be dealt with comes over with the steam itself, the bulk of it entering through the turbine glands and the joints in the exhaust part of the condenser, whilst a small amount may possibly enter through the casing, on account of the existence of minute porous places which are undetected under water pressure. If a condenser is reasonably tight and the turbine glands are in proper order, the air which actually enters the condenser probably does not exceed half the amount which is allowed for, but it is considered advisable to provide air extraction plant of ample capacity.

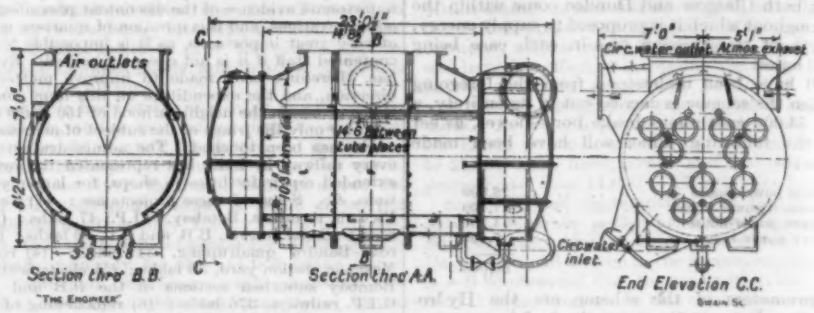


FIG. 178—ENGLISH ELECTRIC CO.—ARRANGEMENT OF CONDENSER

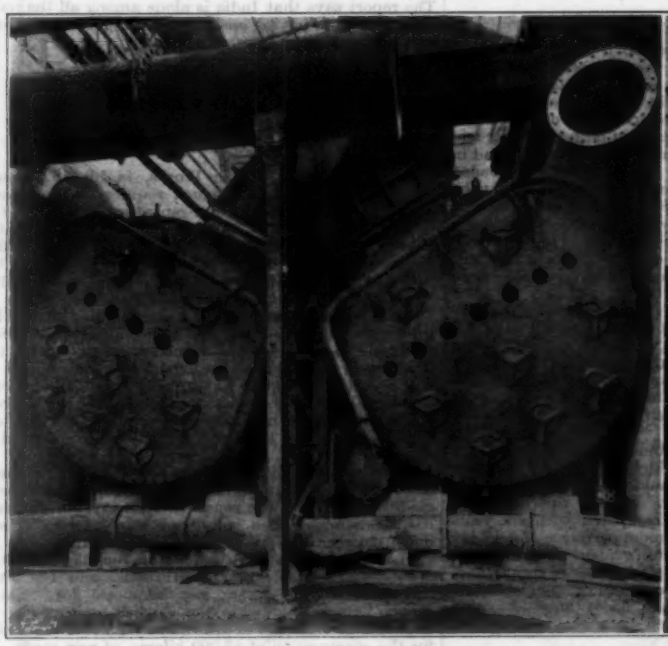


FIG. 179—ENGLISH ELECTRIC CO.—TWO-SHELL CONDENSER FOR ROTHERHAM

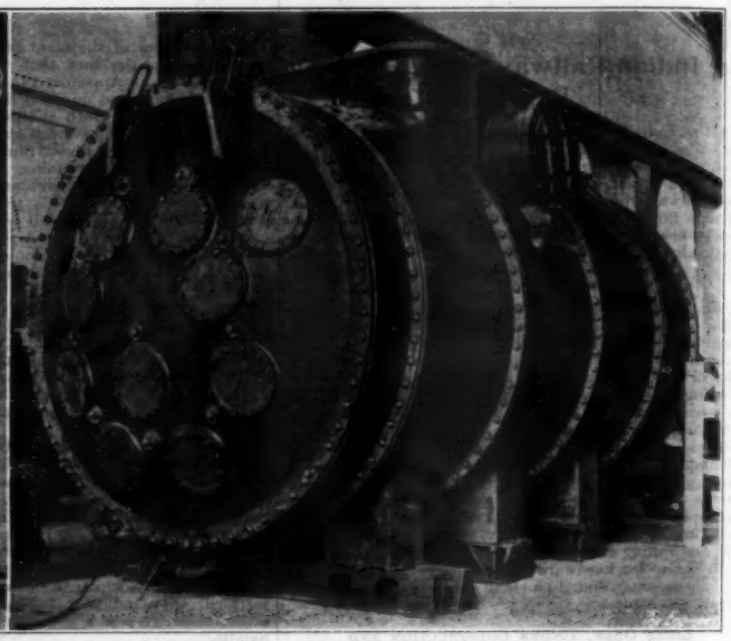


FIG. 180—ENGLISH ELECTRIC CO.—CONDENSER FOR 10,000-K.W. TURBINE

A very important matter which calls for consideration when designing condensers is the fouling of the tubes, which is confined almost entirely to the water side of the wall. The fouling may be caused by soft mud or factory refuse, such as wool combings, &c., or vegetable matter, such as leaves, grass and so forth. If the fouling material is not allowed to cake and dry, it can generally be cleaned out without much difficulty. It is not, however, sufficient merely to clear out the mud, as the tubes must be properly cleaned. Certain waters leave a hard scale that is exceedingly difficult to remove, even when boiling out with acid is resorted to. Hard scale is generally met with where there are cooling towers, and where the water is hard. Since a cooling tower is essentially an evaporator, the circulating water becomes concentrated, and the accumulation of salts becomes a source of trouble. In such cases, the makers of these condensers state, softening plants should be installed to deal with the hard water as well as the make-up water by continuously passing a small amount of the water through them. Once the tubes have been

FIG. 181—ENGLISH ELECTRIC CO.—CONDENSER FOR 15,000-K.W. TURBINE

* No. XXX. appeared May 19th.

attacked, it is almost impossible to get the surface back to the original condition which gives the proper metallic contact with the wall of the metal. By increasing the tube surface allowance can be made, not only for the reduction in heat transmission, but also for increasing the period between the times of cleaning. The load on the station obviously has a bearing upon this matter, and experience alone can determine how much extra surface should be employed.

For facilitating cleaning, various schemes have been devised, such, for instance, as that of dividing the cooling surface of large plants between two shells, thus enabling one part to be cleaned, whilst the other part remains in use. This arrangement, which enables the turbine to be worked at reduced vacuum, whilst the cleaning work is in progress, is particularly advantageous when the turbines are of the double exhaust type, and in the case of large sets, which are provided with two condensers instead of one, in order slightly to cheapen construction. An example of this practice is given in Fig. 179, which shows a condenser with a cooling surface of 50,000 square feet, which was built by the English Electric Company for the electric power station at Rotherham. The exhaust from the 30,000-kilowatt set associated with these condensers is divided into two parts by a breeches pipe. Each of the condensers has a surface of 25,000 square feet and an inside diameter of 11ft. 6in. For small capacities this design would prove expensive, and a single divided condenser—as illustrated in our issue of April 28th—is then used, so that one part can be cleaned whilst the other part remains at work.

To assist in cleaning, a small ejector with return pipes is sometimes fitted to the water box, so that when the main water valves are closed, heated water containing a suitable reagent, such as caustic soda or hydrochloric acid, can be circulated through the tubes. The length of time that should be allowed for boiling depends upon the circulation and also upon the hardness of the scale. In some cases the time allowed may be as short as six hours, but if the conditions are bad a period of twenty-four hours may be necessary to soften the scale sufficiently to enable it to be cleaned out. Obviously, frequent cleaning with a weak solution is much better than cleaning carried out at long intervals with a stronger solution. If the cleaning is done at comparatively short intervals, the condenser will maintain a better vacuum, and the risk of damaging the tube packing is very much reduced. Experiments with hydrochloric acid applied to standard tube grummets soaked in boiled oil, show that a 20 per cent. solution of pure acid or a 50 per cent. solution of cold commercial acid has no effect on the grummets. A 20 per cent. solution of commercial acid heated to 140 deg. Fah. was also found to be ineffective, but when the temperature was raised to 180 deg. Fah. a slight weakening of the treated grummets was noticeable, whilst untreated grummets rotted. The treated grummets also rotted when boiled in the same solution for ten minutes. The experiments clearly indicated that a 20 per cent. solution of commercial acid should be limited to a temperature of 140 deg. Fah., and even this temperature is not permissible if the cleaning has to be done frequently.

As in many other present-day engineering problems, the transportation factor enters into the design of condensers, for the limitations imposed by the British loading gauge have an important bearing upon the size and weight of the parts. Generally speaking, condensers with an internal diameter of 8ft. can be tubed at the maker's works and delivered complete, but in the case of condensers above 9ft. in diameter, it is nearly always impossible to deliver the shell in one piece. Condensers with shells up to 11ft. 6in. can be made in rings and transported to their destination, but when the diameter exceeds 11ft. 6in. it is practically impossible to adopt the ring construction, and the body and water boxes must be divided into segments. This form of construction is, however, considered objectionable, not only on account of cost, but also for structural reasons. Since about 25,000 square feet is the greatest surface that can be accommodated in the ring type body, the segmental type of construction must be adopted for all large units of 20,000 kilowatts and upwards. Generally speaking, small condensers require four water passes medium-sized condensers three passes, and large condensers two passes.

An example of one of the English Electric Company's medium-sized condensers is shown in Fig. 180. This condenser, which has a surface of 20,000 square feet, is designed for dealing with the exhaust steam from a 10,000-kilowatt steam turbine built for the Sheffield Corporation, the whole of the condensing equipment for the set being constructed by the English Electric Company. The body is composed of three rings and the flanges of the two middle joints are carried across the exhaust opening. The cooling water makes two passes through the tubes, the inlet being at the bottom and the outlet at the top. In accordance with standard practice, the water branches are attached to the water box and are independent of the cover, so that the latter can be removed and easily replaced.

The return water box consists of a ring with a cover similar to the inlet door. There are 7030 tubes, which are ⅝in. in diameter by 18 I.S.W.G. thick. They are supported at the ends by rolled brass tube plates having stuffing-boxes packed with hemp tape grummets, which are soaked in boiled oil and are tightened up by brass ferrules having an internal

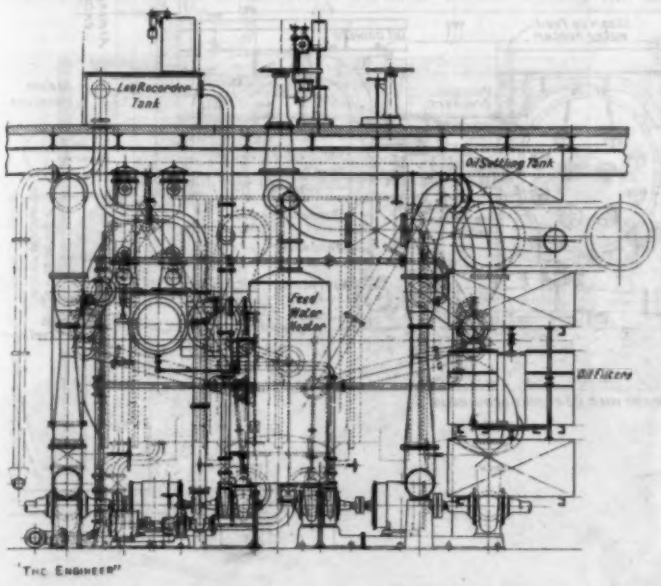


FIG. 182—CONDENSING PLANT AT DALMARNOCK

FIG. 183—WILLAN'S WATER-JET AIR EJECTOR

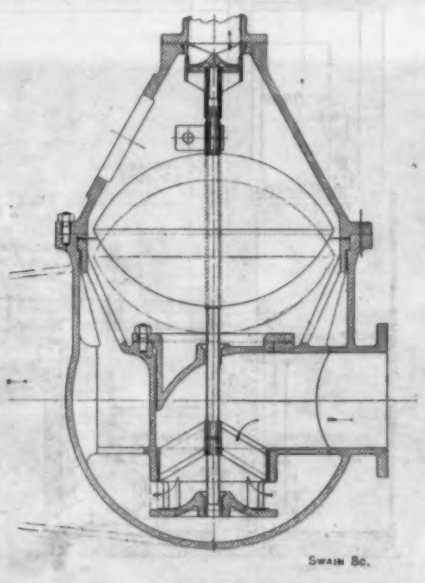


FIG. 184—WILLAN'S AIR SEPARATOR

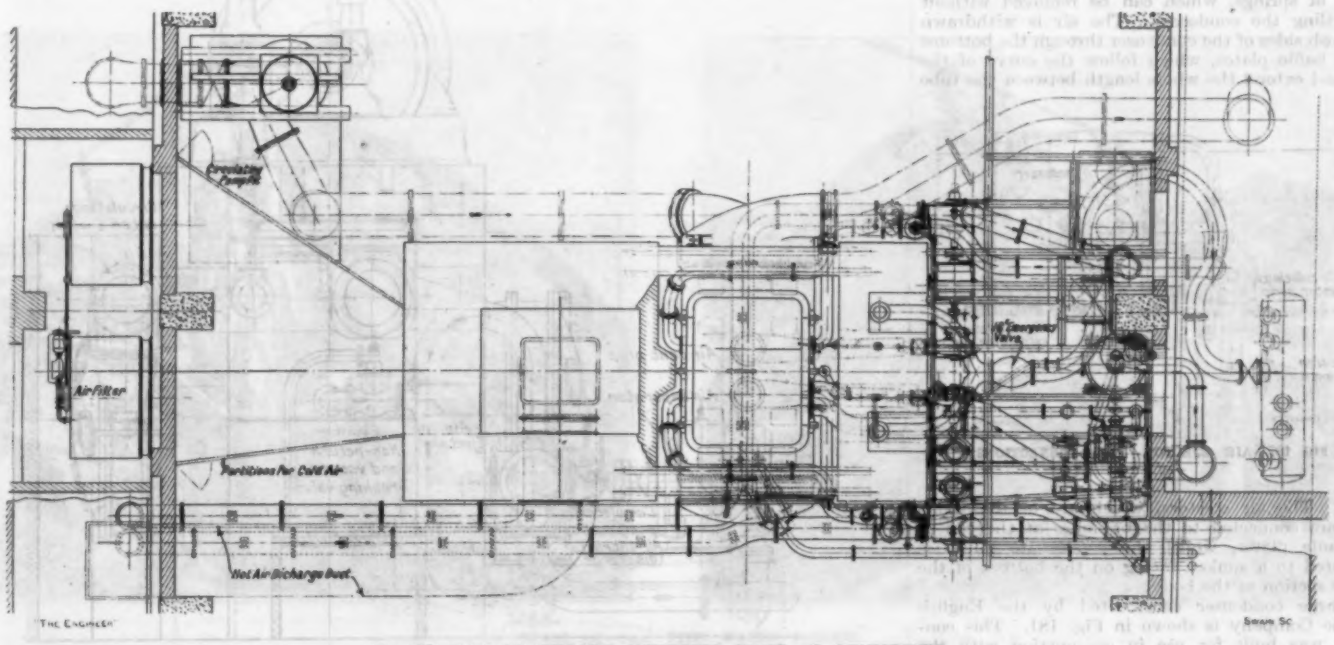


FIG. 185—PLAN OF WILLAN'S CONDENSING PLANT AT DALMARNOCK

lip at the outer end to allow the tubes to expand without displacement. The ferrules have well-rounded ends to enable the water to enter and leave with ease. Intermediate supporting plates composed of rolled brass help to carry the weight of the tubes and water. The steam enters a large rectangular opening, measuring 8ft. 8in. by 7ft., and this, together with a large V-shaped lane, gives a perfect distribution of the steam over a large number of the tubes. The tube plates are supported by a recess in the body flange and are screwed to a heavy cast iron girder across the condenser. They are also stayed to the cover by a number of bolts, which pass through distance pieces. Hydraulic joints are made on both sides of the plates where the stays pass through. Each cover is fitted with a large number of inspection doors, which are arranged so that the doors of one cover stagger those of the other, with the result that it is possible to see through nearly all the tubes by placing a lamp at the opposite end of the condenser to that from which the observer stands. The condenser is bolted directly to the turbine exhaust flange, and is supported on six groups of springs, which can be removed without dismantling the condenser. The air is withdrawn from both sides of the condenser through the bottoms of two baffle plates, which follow the curve of the body and extend the whole length between the tube plates. The air ejectors, which are of the water type, are connected to the branches at the top of the baffle plates, whilst the condensate pump is connected to a sunken facing on the bottom of the middle section of the body.

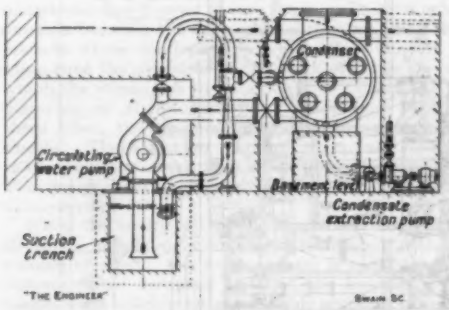


FIG. 187—AIR EJECTOR PIPE CONNECTIONS

A large condenser constructed by the English Electric Company is shown in Fig. 181. This condenser was built for use in conjunction with the company's 15,000-kilowatt turbine and generator installed in the Dalmarnock power station, belonging to the Glasgow Corporation Electricity Department. The cooling surface is 26,000 square feet, and the plant has been built to maintain a vacuum of 29.1in., with circulating water at a temperature of 50 deg. Fah. The special arrangement of the water boxes shown gives an easy stream-line flow to the water from the 40in. pipe line into the tubes, and from the tubes to the return pipe. With this arrangement the frictional resistance involved in getting the water into the condenser and out again is reduced to a minimum, and the power required for operating the circulating pump is also reduced. The water boxes are large enough for men to work in when retubing or cleaning, the large door on the opposite side of the condenser being removed. On account of the Scottish railway loading gauge being less than the English gauge, the condenser had to be made slightly elliptical. Each ring section was placed on its side on special trucks, in order that the railway company might easily handle them.

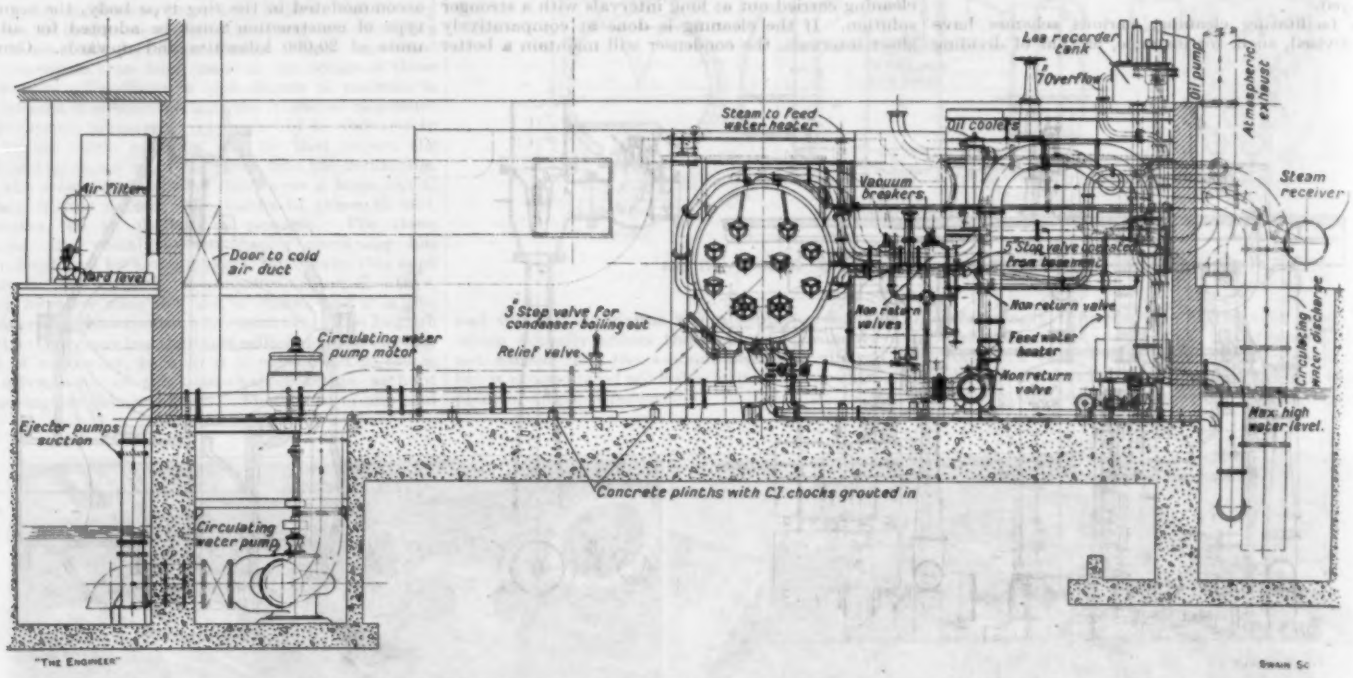


FIG. 186—ELEVATION OF WILLAN'S CONDENSING PLANT AT DALMARNOCK

The Willans water-jet air ejector—see Fig. 183—consists essentially of four stationary parts. The nozzle box A is composed of a cast iron chamber, with a branch B for the air pipe from the condenser. The bronze nozzle C extends downwards from the top of the box to within a short distance above the bottom flange, whilst the water supply pipe is bolted to the top of the nozzle box, the purpose of the nozzle being to convert the pressure of the water into velocity. Inside the nozzle is a cone part D, with vanes arranged on an angle, so as to give a rotary motion to the water, and at the same time it breaks up the surface of the cone of water, so as to enable it to entrain the air with maximum efficiency. The water discharges into the diffuser E, which is bolted to the bottom of the nozzle box. In the diffuser the entrained air is compressed from the vacuum pressure to atmospheric pressure, and the compression is carried out isothermally. The arrangement of the air ejector plant as a whole varies according to the conditions of the site, and is governed almost entirely by the circulating water system. If the circulating water is brought to the power-house in a channel or large culvert, and is returned from the power-house by the same method, the circulating pump has only to overcome the friction of the water passed through the condenser and the small amount of pipe work involved. Under normal conditions, therefore, the manometric head on the pump averages 10ft. to 15ft. This head is insufficient for the air ejector, and it is consequently necessary under the above conditions to provide a separate pump for supplying the water for the air plant.

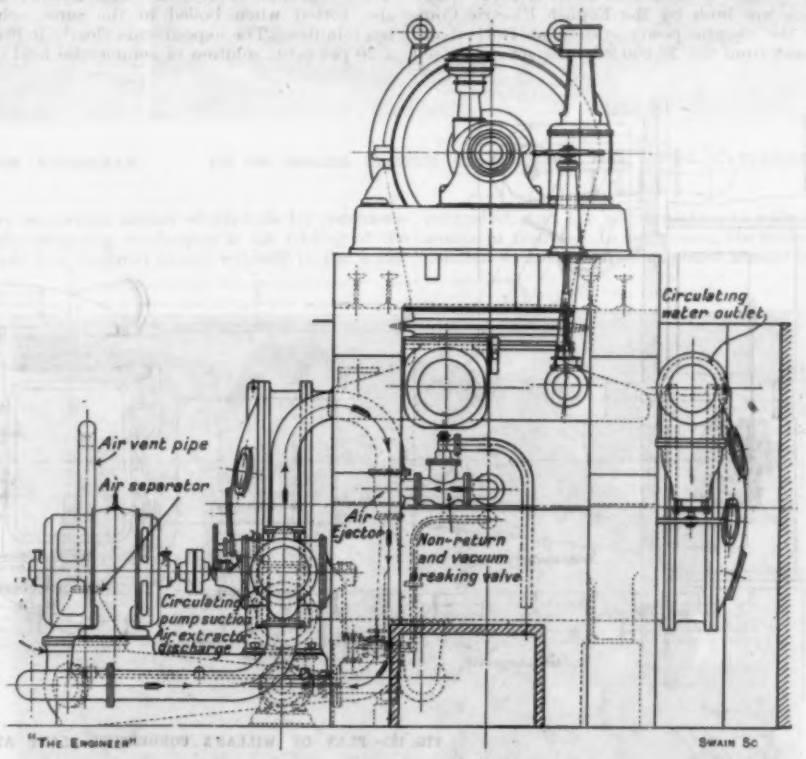


FIG. 188—ARRANGEMENT OF WILLAN'S AIR EJECTOR AND AIR SEPARATOR

After the water has been passed through the air ejector, it can be returned to the suction culvert, where, owing to the fact that the pump suctions are not very near the ejector discharge, the air separates out. When cooling towers are in use and when the main circulating pump has to lift the water to the top of the tower, the head on the circulating pump may be as great as 35ft., or even more, according to the relative levels of the circulating pump and the cooling tower pond. In such cases it is convenient to provide a branch on the pipe between the circulating pump discharge and the condenser inlet, a quantity of water being shunted off the system, and after

it has passed through the air ejector it is returned to the suction culvert. If, however, the water is led to the circulating pump through a closed pipe, it is then necessary to provide an air separator between the air ejector discharge and the pump suction. The former arrangement is shown in Fig. 187 and the latter in Fig. 188. The air separator—see Fig. 184—consists of a conical cast iron vessel, and the water entering at the small end is reduced in velocity as it travels towards the large end. When the velocity falls below about 1ft. per second, the air is separated from the water, and is discharged through a vent pipe at the top, whilst the water returns to the main

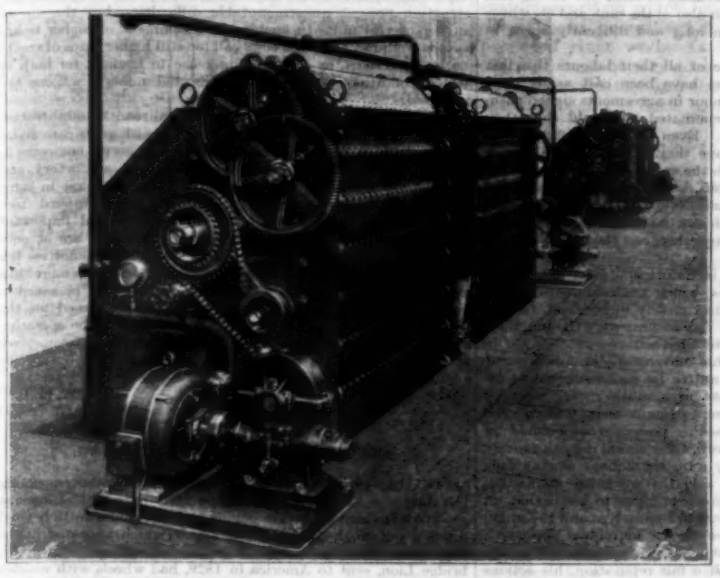


FIG. 189—VERTICAL BAND WATER SCREEN

FIG. 190—INCLINED BAND WATER SCREEN

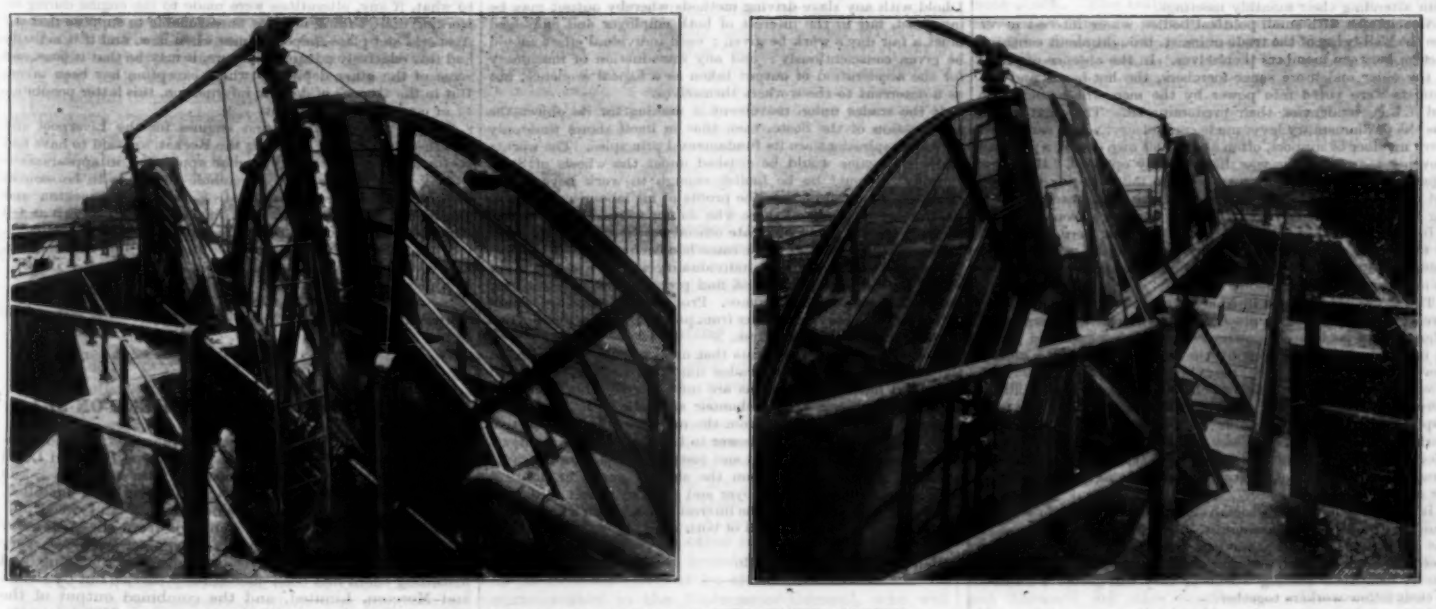
circulating pipe suction. If the water levels involve either a pressure or vacuum in the air separator float control valves are fitted, as shown in Fig. 184.

As the air is separated from the water it accumulates in the top of the vessel, and gradually depresses the water level, thus lowering the float and slightly opening the air valves at the top, so as to allow the air to escape. If, however, there is a tendency for the pump to draw the water out at a greater rate than that at which it enters the separator, the float continues to fall, and closes the water outlet valve at the bottom. In places where the water levels are reasonably constant, however, it is unnecessary to fit these valves. When the water conditions do not enable the above arrangement to be adopted, an open tank is provided, and the water is drawn from the bottom by an ordinary centrifugal pump, which discharges through the air ejector and back again into the tank. Because of the fact that mechanical work is done on the water it becomes heated, and a certain quantity, which is controlled by an ordinary valve, is drawn off, and cold make-up water is led into the tank through a valve which is actuated by a ball float. In this way the temperature of the tank is kept within 5 deg. or 10 deg. in excess of the temperature of the cold water. As the volume of the air to be dealt with by the air ejector depends upon the partial air pressure between the actual vacuum in the condenser and the temperature of the operating water, it is clear that the colder the operating water, the smaller is the volume of air the ejector has to deal with, and consequently by using cold water its capacity in pounds per square inch is increased.

A typical arrangement of the large Dalmarnock condensing plant made by the English Electric Company is shown in Figs. 182, 185, and 186, where air ejectors for dealing with the air from a 15,000-kilowatt plant are shown arranged for taking water from the inlet culvert and discharging it into the hotwell culvert, this scheme having been adopted because the air ejectors were close to the hotwell culvert and the expense of return pipes was therefore avoided.

Reverting to Fig. 183, it will be seen that on the air inlet branch a non-return valve is fitted in the part B, the flap of this valve consisting of a light aluminium casting, and its function is to act in the event of the water jet failing, as the result of too low a pressure when the water would choke in the ejector throat and flow back into the condenser. If the pump failed suddenly, there is a possibility of the water being impelled on to the flap of the non-return valve with sufficient force to fracture it, and in order to prevent this occurring a vacuum-breaking arrangement is provided at F. This consists of a cylindrical piston valve, which is held against the upper seat by means of water under pressure, which is supplied through the pipe G. As long as there is pressure in this pipe, the valve is held up and the ports are closed, but in the event of the water pressure varying, the spring pushes the valve down and opens the ports, thus breaking the vacuum in the space between the non-return valve and the air ejector nozzle, with the result that the force of impact of the water on the non-return valve is reduced. As a matter of fact, however, although these valves have been fitted to a considerable number of condensing plants, which have been at work for some years, they have not as yet been known to come into action.

The removal of floating leaves, twigs, fibre and other solid materials from the circulating water of condensers has presented a somewhat difficult problem, and various forms of filters have been devised for that purpose. The self-cleaning circulating water screens made by F. W. Brackett and Co., Limited, have been put into service at a number of important stations. Generally speaking, the band type of screen, as shown in Figs. 189 and 190, is used, where the water level varies over a wide range, but when the level is reasonably constant, the disc type of screen, as shown in Figs. 191 and 192, is used; whilst for screening water or sewage which contains a large amount of heavy *débris* the raking type of screen is usually adopted. In deciding what size of screen mesh shall be employed for any particular installation, attention must, of course, be paid to the size and nature of the rubbish it is desired to remove from the water. The screen of the band type apparatus consists of a long frame, which may be vertical or inclined, as shown in Figs. 189 and 190. The endless band is perforated, and it passes round a revolving drum at the top of the frame.



FIGS. 191 AND 192—DISC TYPE WATER SCREENS

The circulating water flowing through the screen, first encounters the rising side of the band, and deposits the floating rubbish upon it, whilst the cleaned water passes to the pumps and condensers. The solids, which adhere to the front of the band, are slowly elevated out of the sump, and are finally washed off by high-pressure water jets, which play upon the inside of the screen, the solid matter being deposited in a trough at the upper part of the frame. After it has been cleansed, the band passes downwards into the water again, and is turned upwards at the lower end by means of guide rails, which are bolted to the side of the frame, and metal plates prevent the passage of unscreened water past the sides and

bottom of the screen. As the screen is self-contained, it may be withdrawn bodily from the sump by means of eye-bolts. In the case of the inclined type, the frame is supported by means of trunnions, which rest in bearings at the top of the sump. This type of screen need not be lifted, but can be canted on the trunnions until the lower end of the screen has been brought above the water, provided, of course, that the sump is suitably constructed. In the case of the vertical screen, the entire framework rests on substantial brackets, which are cast or riveted to the side of the frame. No driving parts are under water, and all repairs to the driving gear can be carried out without removing the screen from the sump. A safety device is incorporated in the driving gear to prevent damage in the event of excessive load. The cleaning water which is used for the jets may be taken from any available supply, and should have a head of at least 40ft. or 50ft. If no clean water is available, a small centrifugal pump may be employed for drawing the water from the clean side of the screen. The disc type of screen shown in Figs. 191 and 192 was described in THE ENGINEER of November 26th, 1920.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

TRADES UNIONISM.

SIR,—A letter published in your issue of March 31st re "Look-out," by Robert Keddie, in which he states that he does not believe in hiding his light under a bushel, demands interest, because there are lights, if not at times covered, are apt to be blown out by the winds of editorial criticisms; but having read his letter, I have taken this opening to yet further enlightening readers in reference to the sowing of the seeds of anarchical tendencies in the trades union movement.

Some twenty years ago it would have been almost impossible to persuade the majority of workmen that shop rule by their trade union officials would help and strengthen their cause. The trades union movement was then something worth belonging to; it stood for what it was originally intended to be—for collective bargaining between employer and employed, for the upkeep of a living wage, the protection and care of its members in every way, and to help foster the spirit of brotherhood between fellow-workers.

Speaking as one whose membership extends over twenty-five years, there are many recollections of some stirring fights in the trades union movement, but such were legitimate and worthy of participation, and by the honest and straightforward methods used were a credit to all whom it embraced, and although not always resulting in a declared victory was a means of closer unity between master and man. There eventually started a movement whereby the thin end of the wedge of politics was introduced into the club rooms, and let me point out that then were the seeds of anarchical tendencies sown. It was by this move that trade unionism thought to compel its members to support certain factions, whose ambitions were the over-throwing of the whole of the capitalistic *régime*.

It was through the socialistic tendencies shown and discussed at club meetings that caused thousands of members to refrain from attending their monthly meetings.

Associations with small political bodies, whose interest never was the well-being of the trade unionist, brought about constant friction between members themselves. In the absence of many of the older and more sane members, the hot-heads and extremists were voted into power by the men whose socialistic and I.L.P. tendencies then predominated. The next move was the parliamentary levy, made compulsory, which compelled every member to support, often against his own desire, a political movement to which he was diametrically opposed. Here was a position that placed any member who failed to pay this levy out of benefit, should his arrears be above that stated, according to rule. Later, however, this levy became optional.

In many ballots, taken on propositions that were most vital to the whole of the members, only a very small percentage of votes were recorded, which pointed out the apathy into which its members had drifted.

The trade unions have in some measure stultified the initiative of the individual, by placing him in a position whereby his labours were pooled. His own strength of character and power of intellect were held back by the knowledge that no matter how good a workman he may be, his fellow-workers were receiving as much wage as himself, even though their abilities were less, both in trades craft and output. It has, in many respects, destroyed the noble individualism by which hard workers and those of intellect gained their reward. It has effected the levelling up of inefficient workmen and men whose minds were never above the standard of doing as little as possible for as much as possible.

It has for its object the socialisation of the whole of the community. So-called trade unionism has within its ranks some of the most poisonous propagandists that could be found, whose methods are to preach sedition and create unrest. You have but to hear their ranting whenever they can gather a number of their fellow-workers together.

It has taken a war of world-wide dimensions and untold misery to impart to certain individuals that that moment was the opportune time to enforce conditions which only proved to be a shadow.

Only too ready were these so-called trade unionists to create discord. On any little chance and pettifogging occasion would they call meetings, either at meal times or the end of the day's work in the shops, fully knowing that only a few would attend, and those who did were of the same stamp. Motions would be put after scarcely any discussion, and without hesitation voted upon, when perhaps thousands of men would be called upon to down tools, and when some member, whose power of reasoning was not altogether void of common sense, dared to refuse to strike until by a proper and constitutional method, he was made acquainted with all facts, he was deemed a traitor and a blackleg.

It has been the aim of the Industrial Workers of the World movement to capture and ensure within its mesh the trades unions of this country. Its propaganda has in no small way been the means of catching hold of some of the younger members, whose eyes have been partially blinded by the glamour and vivid pictures painted by their agents; in fact, everything but the real and truthful purpose of trades unionism has been instilled within the minds of some unionists.

In all this we see the working of a movement that has a direct opposite effect to that which the trade union movement should, and was originally intended to, have.

We have still some good and true leaders in the trade unions, men whose sincerity and honesty of purpose has been proved, men whose sole ambition has been to help their fellow-workers and whose knowledge has been gained in the fields of wide experience. They have been placed in positions of trust because of their untiring efforts on behalf of that trades union to which they belonged. Men whose advice has been proved to be both wise and logical, and who have steered the ship of unionism through many deep and troubled waters, often bringing it into harbour, perhaps a little weather-beaten, yet strong and just as seaworthy as before; men also of the rank and file whose years of membership have been long and diligently spent in its cause.

But what, I ask, has become of all their labours this last few years? Those same leaders have been cast aside, their advice ignored, their word of honour in agreements signed ruthfully defamed and distinctly repudiated, and told that they are only the servants of a body. Even then their efforts have not been lacking, even then have they turned their shoulder to the wheel, and striven to push the cart up the hill, and, even so, will they continue to do so, but not until the extremists and revolutionists who never were, and never intended to be, honest workmen, are entirely eradicated, not until the staid and logical thinkers come once more closer together, can the efforts of good leadership be really upheld.

The shop steward movement in its original form was meant to deal only with the principles which trades unionism stood for, and therefore executed a duty clearly understood, for the protection of its members alone. At no time were the functions of management desired to be interfered with.

But what in late year has this movement developed into? We see the shop stewards committee formed, connived at by socialistic and extreme actionists, as a subtle means whereby surreptitiously the duties of management were undermined, and in time greater and far-reaching powers were claimed by these bodies, until, as we have seen, their actual intentions were revealed. Gradually and surely were the actions of managers and foremen interfered with; also the workmen themselves were, by threats and intimidations, brought to learn that an honest day's work was detrimental to themselves and the union they belong to. Here, again, we see the individual oppressed, for should he desire to keep within his principles honestly, and desiring even to gain for himself a fair reputation, his actions were in the eyes of the shop stewards those of blackleg tendencies, and thoroughly was he made aware of the principle of ca' canny, which was, so he would be told, much more to his and his fellow-unionists' interest than individual merit, until it became in many shops more tyrannical than the most severe and strictest management could be. No workman must interview his manager alone, no small grievance can be amicably rectified, nothing allowed to be brought before the management, only by deputation, and then again brought before the shop stewards—thus many times enlarging the matter out of all proportion. This was again interfering with the rights of management.

In respect to the shorter working hours, it has been, in many instances, recognised by employers to have had a beneficial result upon output—that is, where the principles of the agreement entered into were upheld and duly carried out—but no sane man can believe that the ca' canny movement could bring that desired result, and bring about the fulfilment of the promise entered into the agreement that was honestly signed in the name of the rank and file of trades unionism. I in no way desire or believe in the return to the longer working day, neither do I hold with any slave-driving methods whereby output may be increased, but in the interest of both employer and employed must a fair day's work be given; each individual effort should be given conscientiously; and any introduction of machinery for the acceleration of output taken as a logical sequence, not as a deterrent to the workers themselves.

If the trades union movement is making for its object the socialisation of the State, then that in itself shows that only political aspirations are its fundamental principles. The worker under its *régime* would be crushed under the wheels of State tyranny. Should he be foolish enough to work beyond the minimum required of him, the profits of his labour would go to pay for the pleasures of those who do not work. Every opportunity would be given to create official positions for those trade unionists whose activity in the cause had been noted as deserving.

No man whose pride of individuality is his greatest asset would be able to advance and find promotion as a reward for his intelligence and perseverance. Productivity set to a standard of limitation debars the worker from partaking of his just portion of the profits arising therefrom.

These are some of the points that must be fully recognised in the present trend of the trades union movement, and until wiser and more logical means are introduced within its ranks, nothing but distrust and dishonour can follow. It must, and at no distant date, collect from the more sane and intellectual of its members, men whose power to lead and control its movements are based upon a firm and justified foundation of trades unionism only, and not upon the shifting sands of political aspirations. Then can employer and employed meet to discuss all matters appertaining to the interest of both with a knowledge of the sincerity and good will of both sides.

T. R. SHIPLEY.

Melton Mowbray, May 24th.

TRANSPORT PROBLEMS.

SIR,—A more important subject could hardly have been chosen at the present time than that which Sir John Aspinall selected for the James Forrest Lecture delivered by him to the Institution of Civil Engineers on the 2nd inst., and one may regret that it was not open to discussion.

The figures given relative to the average daily mileage of steam locomotives and multiple unit electric trains are interesting, but hardly form a basis on which to make the deductions arrived at as to the comparative daily mileages possible with steam and electric working. Multiple-unit trains are for the most part employed on almost continuous shuttle services—ideal for large mileages. The steam locomotive is working trains of all descriptions, subject to detentions of every kind, and but a small percentage of the time actually lost whilst standing is really due to the requirements of the locomotive for fire cleaning, oiling, &c. Numerous instances could be quoted of locomotives making considerably more than 200 miles per day, and mentioning some of historic interest, the work of the North-Western engines, Charles Dickens, and the Webb compound Jeanie Deans, may be recalled. The former for many years ran between Manchester and London, and the latter between London and Crewe, making daily train mileages of 366 and 316 respectively, whilst Webb's engine Greater Britain ran 3588 miles in six days during some special trials in 1893, representing 598 miles per day.

I must confess that I can hardly follow the lecturer in his remarks relative to the electrification of main line working, as being more especially suitable for goods trains. As I see it, the steam locomotive will easily more than meet all demands that can be made on it for some time to come, so far as goods trains are concerned, for here it is not so much a question of providing adequate motive power as the suitability of existing freight stock to meet the conditions imposed by heavier loads at higher speeds. Large electric or steam locomotives of 60,000 lb. tractive effort do not from the point of view of construction present unsurmountable difficulties, but the use of such powerful units to enable the attainment of higher uphill speeds would at the same time call for still higher rates of travel on level sections, or a relative increase in loading, for both of which conditions our present goods and mineral wagons are unsuited.

During the war the United States Railroad Administration introduced standard locomotives designed with great care under the supervision of some of the foremost locomotive engineers in the country, but the results were anything but satisfactory, and in this connection it is interesting to point out that in some instances locomotives have more recently been supplied from designs based on the standard, but with several important changes to meet conditions. Thus the standards are at once destroyed. One of the dangers with standard locomotives lies in the fact that they cannot meet general conditions in more than an average sense, so that although something may be saved in first cost, the engines not being specifically designed for the services on which they are employed, cannot give the operating results which may reasonably be expected from locomotives specially designed to meet the conditions imposed by specific traffic and road characteristics.

May 24th. P. E. C.

LOCOMOTIVE COUNTERBALANCING.

SIR,—In reply to Mr. E. A. Forward's second letter respecting the Agenoria—THE ENGINEER, May 12th, page 520—I have at present no evidence that the engine had cast iron wheels, beyond a statement to that effect in an article which appeared in the *Locomotive Magazine* on the Shutt End Railway. The Stourbridge Lion, sent to America in 1829, had wheels with wooden spokes and rims and the tires were of wrought iron.

It may be that the supposed dome of the last-mentioned engine was merely a manhole cover. Be that as it may, the "dome" is shown in different positions in different drawings.

In Pettigrew's "Manual of Locomotive Engineering" will be found a dimensioned elevation and plan of the Agenoria, showing both the dome at the rear end of the boiler and the counterbalance in the hind wheels. The question is, When was this drawing prepared? There is a manhole in a position corresponding with that of the Stourbridge Lion. The dome proper may, or may not, have been an afterthought. Plate-shaped frames are also shown. This type of framing was not, I believe, adopted by Stephenson until he brought out his "Planet" class in 1830. Were the Agenoria's frames also a latter-day feature, fitted some time after she was first constructed? The drawing in question is complete in every detail, and undoubtedly is a correct representation of the engine at some period or other, apart from its being like the engine as it is now in the South Kensington Museum. In their catalogue of exhibits, the South Kensington people, in describing the Agenoria, give no hint as to what, if any, alterations were made to the engine during its working life. I think it is not unreasonable to suppose that the Agenoria had plate-shaped frames when new, and if it actually had this relatively advanced feature, it may be that it possessed some of the other details to which exception has been taken. But in the absence of definite information, this latter possibility is, of course, open to doubt.

Oh, yes; some of the first engines for the Liverpool and Manchester Railway, including the Rocket, are said to have had steam domes. A precisely similar appendage in appearance—it may merely have been a manhole cover—is to be seen in drawings of Stephenson's 0-6-0 Experiment, Stockton and Darlington Railway, 1826, and in the sketches of his 0-4-0 America, of 1838, for the Delaware and Hudson Canal Company.

I am, however, making further inquiries into this matter, and will deal with it, if at all, under the subject of "Domes," to which the discussion has now drifted.

F. W. BREWER.

Stevenage, Herts, May 20th.

DIESEL ENGINES AT SOUTHEND-ON-SEA.

THE extensions to the electrical plant at the London-road generating station, also at the Thorpe Bay and Leigh sub-stations at Southend-on-Sea, are now completed, and at each station two Diesel engines have been installed. They are ex-German submarine engines, and were purchased complete with their dynamos from the Admiralty at a time when the delivery of new machinery was very uncertain. The work of overhauling, re-conditioning, and installing them has been successfully carried out by Bellis and Morcom, Limited, and the combined output of the six engines at their modified rating is over 2500 kilowatts. The engines have been altered to suit power-house conditions, and Hoenan and Froude water coolers are used for cooling the circulating water for the cylinders, exhaust valves and exhaust pipes. At the London-road station the exhaust gases are led through an economiser, and serve to heat the feed water for the steam boilers. The total cost of the Diesel installation worked out at a little more than half that which would have had to be paid for new plant, and the generating costs since the Diesel engines were installed have, so we are informed, shown a marked reduction.

DURING the year 1921 only four passengers were killed in train accidents on the Canadian railways and 91 servants. There were 240 passengers and 1344 servants injured in train accidents.

A Seven-Day Journal.

Wireless Position-finding for Aircraft.

IN a "Notice to Airmen," just issued by the Air Ministry, pilots are urged to take advantage on every flight, even in good weather, of the wireless position-finding service operated from Croydon, the object being to promote the experience and encourage the confidence of all concerned. Up to October last, the Civil Aviation Wireless Station at Croydon could only give a pilot his compass bearing from that station. Since the month named, however, a similar direction-finding station has been in operation at Pulham, Norfolk, and has been connected up to Croydon by means of wireless telephony. It is therefore now possible accurately to communicate to a machine in flight its position by means of the usual method of plotting its compass bearings from the two stations and finding the point of intersection. The radius of action of the service is about 200 miles from Croydon, and in normal circumstances the position of a machine can be communicated to it within two minutes. The service is ordinarily operated by means of wireless telephony, but by means of a simple switch it can be changed over in a few seconds to wireless telegraphic operation. A machine has already been flown from Paris to London with the navigation based entirely on the position-finding service, the pilot being debarred from seeing the ground except on one occasion for a few minutes.

Private Post Marking Machines.

THE use of post marking machines by private firms and others dealing with large volumes of outward correspondence has been officially authorised by the Postmaster-General. The machine to be used is the Pitney-Bowes postage meter, an American invention, which will be manufactured in this country by a British firm. It prints the post-mark directly on to the letters, and is combined with a small detachable meter which registers the number of letters put through the machine. The meter is set at the post office for a given number of letters, and stops the operation of the machine when that number has been exhausted. The device can deal with from 250 to 300 letters a minute, and being very simply operated will, it is believed, result in considerable saving, not only to the Post Office, but to those firms which adopt it. The first machine, we understand, is about to be put into use in the office of the Prudential Assurance Company.

The Late Mr. G. R. Hislop.

THE death of Mr. George Hislop, gas manager and engineer for the Burgh of Paisley for fifty-three years, has removed a prominent and familiar figure in the gas manufacturing and gas engineering world. He was in his eighty-seventh year on the date of his death, the 18th inst., and had been connected with the production of gas since his childhood. His father was for many years manager of the Lanark Gasworks, and on his death his two sons carried on his work, in spite of the fact that at the time the late Mr. Hislop was but thirteen years of age and his brother only two years his senior. Subsequently he became gas engineer and manager at Falkirk, and then at Coatbridge. In 1865 he was appointed to a similar post at Paisley, a position which he held continuously until his retirement in 1918. He was a Fellow of the Chemical Society, and was on three occasions President of the North British Association of Gas Managers.

The ex-German Liner Tirpitz.

THE Canadian-Pacific liner Empress of Australia—formerly the German vessel Tirpitz—is, we learn, expected to arrive this week in the Clyde for final trials. Since being taken over by the company she has been very thoroughly overhauled. In several respects she is an unusual vessel. Her boilers are of the water-tube type, and are oil-fired, while her turbines are geared down by means of Föttinger hydraulic transformers. The thrust blocks as now fitted are of the Michell pattern, the original multi-collar blocks of the usual design having been removed on account, it is understood, of defects manifested during an early trial. The vessel has already passed successfully through preliminary trials at Hamburg.

Liverpool Dock Developments.

AN important scheme for improving the Gladstone dock system at Liverpool, involving an expenditure of over £400,000, has been submitted to the Mersey Docks and Harbour Board by Mr. R. D. Holt, chairman of the Board's Works Committee. At present the Gladstone graving dock does not form part of the Gladstone dock system, but has to be entered separately from the river. The new scheme contemplates enclosing the graving dock by means of a wall which would shut off the river entrance and opening a passage-way direct from the dock system to the graving dock. The proposed alterations, if carried out, would incidentally greatly facilitate any future extension of the dock system northwards, for at present the entrance to the graving dock cuts across the region required for access to such extension from the existing dock system. The alteration to the graving dock entrance, it is urged, should be undertaken at once in order that the material now being excavated from the new entrance lock to the dock system, work on which has been proceeding for some time, might be utilised for the construction of the proposed river wall. It is believed that the new entrance lock to the dock system will be completed in two years' time, and that the graving dock scheme could, if begun at once, be finished simultaneously.

A Large Trades Union Combination.

LAST Saturday, at the annual conference in London of the Associated Society of Locomotive Engineers and Firemen, a large majority vote was recorded in favour of linking up the organisation with the National Transport Workers' Federation. The complete scheme covers similar action on the part of the Railway Clerks' Association and the National Union of Railwaymen, and will come before these bodies at their annual meetings. If the scheme goes through in its entirety it will add over 700,000 members to the Transport Workers' Federation and raise that body's roll to about 1,100,000.

A Derelict London Tube.

FORTY or fifty years ago the Pneumatic Dispatch Company constructed an underground tube between the General Post Office and Euston by way of Holborn and Tottenham Court-road, but for the past thirty years or so the tube has not been used for its original purpose. In a Bill read a second time in the House of Commons, on the motion of the Postmaster-General on the 22nd, the Post Office seeks to ratify an agreement which it has come to with the company under which the Post Office proposes to use the tube for the purpose of carrying telephone cables. It is estimated that by so using the tube about £40,000 would be saved, while, in addition, the breaking up of some very busy thoroughfares would be avoided.

The Grampian Electricity Supply Scheme.

THE Grampians Electricity Supply Bill, as reported on and amended by the Committee appointed to inquire into it, was considered in the House of Commons on Tuesday evening. Chief opposition to the Bill was voiced by Mr. Briggs, a member of the Committee of Inquiry, who took exception to the action of the Trade Facilities Advisory Committee in the matter. That Committee, he said, had written to the promoters stating that it would advise the Government to guarantee the issue of £2,000,000 in debenture shares, and the promoters had announced their intention of advertising this fact in their prospectus. He held that the scheme was speculative, and that the assets of the company were not sufficiently substantial to justify the Government in guaranteeing the shares. The money required, he maintained, could easily be found by the company without the Government's intervention, for the scheme was being supported by many London banks and financiers. The company, however, feared the risk and asked the Government to take it. On a division, 185 voted for the Bill and 78 against it.

A Broadcasting Conference.

UNDER the chairmanship of Mr. Godfrey Isaacs, a private conference of wireless apparatus manufacturers interested in the broadcasting of public radio-telephonic services was held on Tuesday at the headquarters of the Institution of Electrical Engineers, with the object of devising a scheme of co-operation. Twenty-three companies are ready to engage in the work, but it is thought that the number should be limited to about twelve. At present only two stations, one in London and the other in Manchester, are fully equipped to undertake broadcasting work forthwith. The decisions arrived at by the conference are to be communicated to the Postmaster-General, who will shortly make an announcement regarding the initiation of broadcasting.

The Loss of the Liner Egypt.

THE disaster which overtook the Peninsular and Oriental liner Egypt last Saturday night off Ushant seems to suggest that in spite of all recent improvements in means of navigation the perils of sea transport are still considerable. The scene of the collision between the liner and the French cargo steamer Seine is notoriously dangerous, and has a long record of previous mishaps extending over the past one hundred years. In this instance its natural dangers were enhanced by the prevalence of a thick fog. The peril of the situation was also increased by the fact that the disaster occurred at a point on the main route of vessels passing from the Atlantic into the Channel. Fortunately, however, no second collision occurred, as in the case of the Rowan in similar circumstances off the Wigtonshire coast last October. The Seine, it appears, struck the Egypt amidships on the port side. Although she was of but one-sixth of the tonnage of the Egypt, she inflicted great damage, a fact which may perhaps be accounted for by her having been specially built for navigating in partly frozen waters. Within twenty minutes after the impact the Egypt sank. The Seine herself was badly damaged, but stood by and rescued many of the liner's passengers and crew. According to the latest information, sixteen out of the forty-four passengers on board and eighty-six out of the crew of 290 are missing. The Egypt was a single-screw vessel of 7491 tons gross, built at Greenock in 1897. The Seine has a gross tonnage of 1383, and was built at Newcastle in 1899.

The Mystery Towers Again.

FURTHER to the note in the Journal of April 7th, we have now to record a few additional facts concerning the so-called mystery towers, gleaned from the remarks made in the House of Commons on Tuesday in the course of the consideration of the Naval Estimates. It appears that at the date of the Armistice there were fourteen "towers" under construction. Since the Armistice a sum of about a million pounds has been spent on them, partly for the purpose of completing the two which had reached an advanced stage at Shoreham, but principally on the demolition of the other twelve. One of the completed towers is now in use taking the place of the old Nab Lightship and for certain undefined experimental purposes. A sum of £17,000 has just been voted for the demolition of the second completed tower, which still remains in Shoreham Harbour. Altogether the sum of £1,180,000 represents the bill which the country has to meet in connection with the construction and demolition of these towers, the precise function of which has never been officially disclosed.

The G.W.R. and Swansea Harbour.

THE whole of the Swansea Harbour undertaking, representing a capital investment of about four million pounds, has, as a result of the negotiations previously reported, been acquired by the Great Western Railway subject to a formal contract, the confirmation by the Harbour Trustees, the approval of Parliament, and the sanction of the Court. The Harbour four per cent. stock is to be taken over by the railway company on the basis of £100 nominal Harbour stock in exchange for £80 Great Western five per cent. guaranteed preference stock. The railway company is to meet all the arrears of interest on the Harbour stock, now three years in default. It is hinted that the acquisition of the harbour may eventually lead to Swansea's becoming a big ocean port for dealing with large Atlantic liners.

The Engineering Dispute.

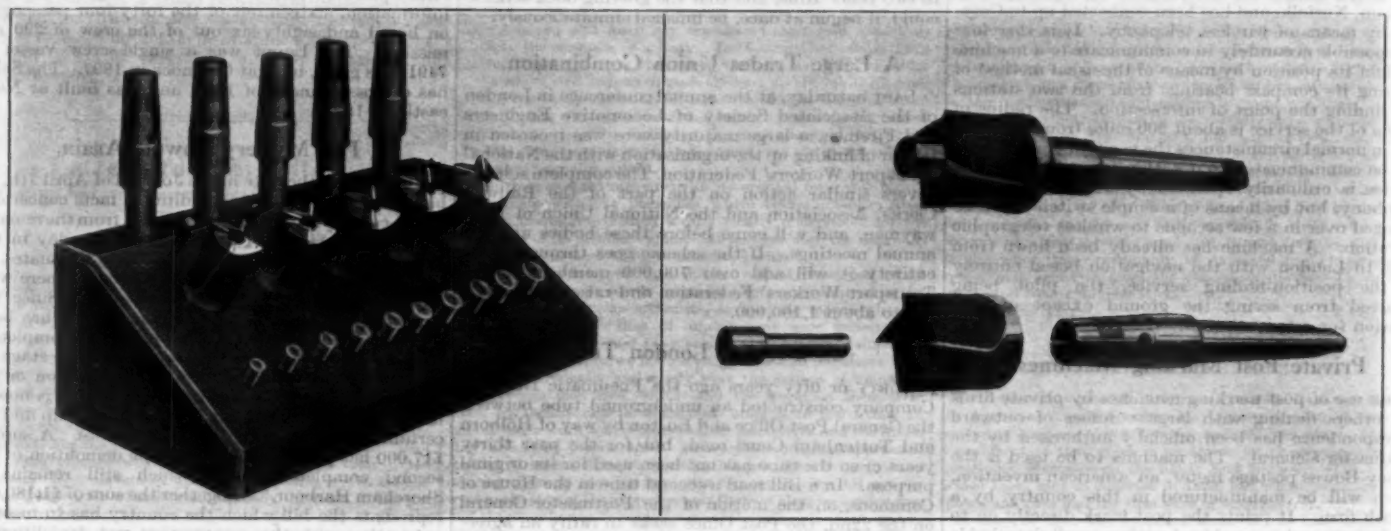
AS recorded in last week's issue, the conference between the engineering employers and the representatives of the engineering trades unions, arranged as an outcome of Sir William Mackenzie's Court of Inquiry, suffered a partial breakdown as the result of the decision of the Amalgamated Engineering Union to withdraw, the ground advanced for such action being the allegation that the employers' new terms were the same in principle as those which that union had on ballot already rejected. The representatives of the remaining forty-seven unions decided not to follow the Amalgamated Union's lead, and on Saturday reached a provisional agreement with the employers. This agreement was considered by the Executive Councils of the unions on Tuesday, and it was decided to submit it to a ballot vote of the members. The ballot results are to be returned on June 2nd. Meanwhile, the Amalgamated Union, after considering the position, altered its decision so far as to make arrangements to enter into separate conference with the employers on Wednesday morning with a view to submitting counter-proposals to those put forward by the employers. These counter-proposals were found to be unacceptable by the employers, who, in turn, submitted the terms accepted by the representatives of the forty-seven unions. The Amalgamated Union postponed its decision on the matter and, in effect, the conference for the time being came to an end without any advance being made towards agreement.

The South-Eastern Electrification Scheme.

THE South-Eastern and Chatham Rai way, it is learned, proposes to construct an electric generating station at Angerstein's Wharf, Charlton, for the purpose of supplying energy to its North Kent, Mid-Kent, and other sections. An order authorising the construction of the station and other electrical work is now, we understand, being applied for from the Ministry of Transport.

Interchangeable Counterboring, Spot Facing and End Milling Cutters

THE exact value attaching to the combination or interchangeable type of tool, whatever its nature, is difficult to determine, but, broadly speaking, it may be said that this class of instrument is more useful in the general engineering or repair shop than in a works devoted to the manufacture of a product or range of products in which there is a considerable degree of standardisation. A tool of this description, the usefulness of which in the circumstances stated is apparent, is illustrated herewith, namely, a combination counterboring cutter, the invention of Mr. F. F. Sandlin, of 30, Kenilworth-road, Ealing, W. 5. The set illustrated comprises five duplicate holders, five cutters ranging by eighths from 1⅛in. to 1½in. in diameter, and ten pilots ranging by thirty-secondths from ⅞in. to $^{21}/_{32}$in. By means of the set, therefore, fifty different combinations



THE SANDLIN INTERCHANGEABLE COUNTERBORING CUTTER SYSTEM

of cutter and pilot may be obtained, any five of which may be in use simultaneously.

Essential features in a combination tool are ease of assembly and dismantling and accuracy and rigidity when in the assembled condition. Mr. Sandlin's tool consists of only three parts—the holder, the cutter and the pilot—and all three are held together merely by frictional engagement. Assembly is therefore very easy. The cutter is simply slipped on to the nose of the holder and the pilot inserted. A light tap on the end of the pilot then serves to tighten the grip of the cutter on the holder and simultaneously of the holder on the pilot. It will be noted in this connection that the nose of the holder is tapered externally, and is split. The bore inside the cutter is tapered to correspond. The shank of the pilot, however, is parallel, as is the bore in the holder into which it is inserted. The action that takes place when the pilot is tapped is thus the forcing of the cutter up on to the tapered nose of the holder and the consequential closing of the split holder down on to the shank of the pilot. To dismantle the parts a small cotter pin—supplied in five sizes with the set shown in the first engraving—is driven into a hole in the holder just behind the rear face of the cutter. The cutter is thus forced off the cone and the grip of the holder on the pilot shank released. We have examined the tool closely, and found no difficulty either in assembling it or dismantling it in a few seconds. As for its rigidity in working, the inventor points out that the method of holding the elements of the tool is such that they become more tightly held as the pressure of the cut is increased.

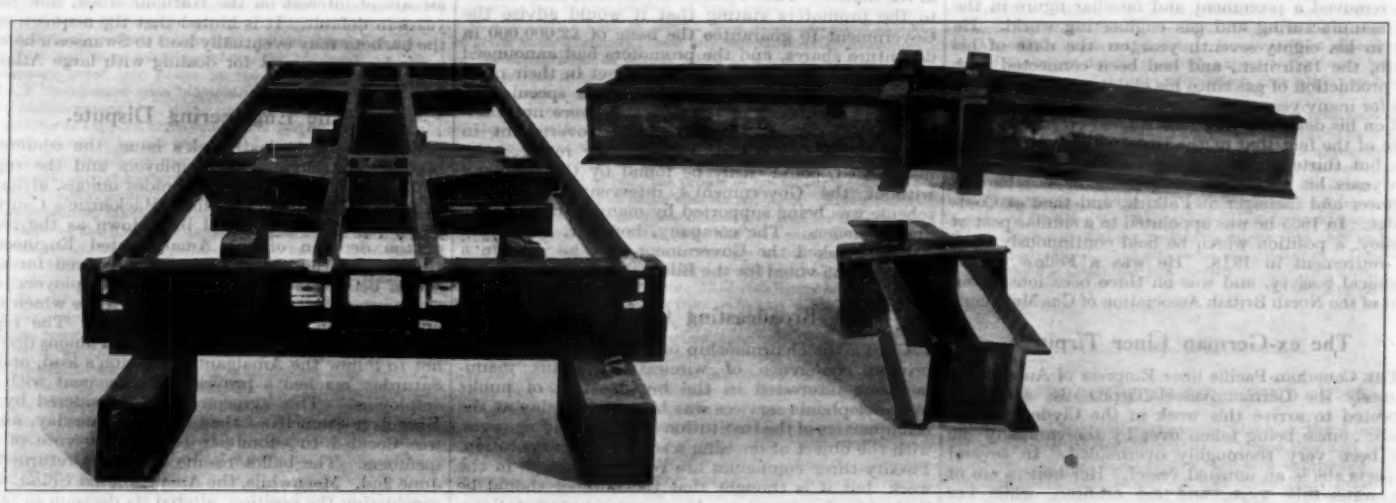
The tool can be used either as a counterborer or as a spot-facing or end-milling cutter. For the latter uses a plain headless pin is employed in place of the pilot. An incidental advantage of the construction of the tool lies in the fact that the pilot being removable the end-cutting edges can readily be sharpened. In the ordinary solid counterborer the pilot is the portion which usually leads to the tool being scrapped, for in the sharpening process it becomes nicked or its size may be destroyed by an effort on the part of the workman to grind it down by hand to suit some temporary requirement.

The sale of this tool has been placed in the hands of Mr. Gregor MacGregor, of Craven House, Kingsway, W.C. 2.

Arc-Welded Locomotive Tender Underframe.

WE have been courteously sent by Mr. E. E. Lucy, the chief mechanical engineer of the New South Wales Government Railways, a drawing and some photographs of a locomotive bogie tender underframe which he has just constructed entirely by autogenous welding, employing the Quasi-arc process. We reproduce the photograph of the underframe itself on the left hand of the accompanying engraving. The parts welded have been whitened to indicate their positions more clearly, and it will be observed, as Mr. Lucy points out, that the method of construction may be described as that common to wood working, namely, by mortice and tenon. The holes in the transverse members are cut by means of the oxy-acetylene blow pipe to a slightly enlarged profile of the longitudinal members, which have to be threaded through. When assembled and squared, the channels are welded in position.

The tender for which the underframe is intended is of the double bogie type, and is designed for carrying 4000 gallons of water and 15 tons of coal. The buffer beams



ARC WELDED LOCOMOTIVE TENDER UNDERFRAME FOR THE N.S.W. RAILWAYS

are channels, 15in. by 4in.; the inner and outer longitudinals are also channels, the former being 12in. by 3½in. and the latter 8in. by 3in. The channels composing the bolsters are 10in. by 3½in., and their lower flanges are cut away at the ends where they join the outer longitudinals, as may be seen in the engraving. The weight of the complete underframe is 3 tons 7¼ cwt.

In order to ascertain its strength, Mr. Lucy made an experimental body bolster by welding together channels of the same sizes as those employed in the actual underframe. The bolster was supported at 9ft. centres in a testing machine, and a load of 75 tons was applied in the centre. There was deformation, as may be seen in the two views at the right-hand side of the engraving, and there was a deflection of 1¼in., but apparently there was no sign of giving way at any of the welds.

Mr. Lucy is of opinion that this method of construction, which he believes is novel, and which he describes as "cheap and efficient," will be of interest to those of our readers who are accustomed to rivet work with its attendant cut-short members made up with gussets and knees.

A PORTABLE CONCRETE GARAGE.

A CONCRETE garage that can be delivered on an ordinary truck and that can be erected and made ready for occupancy in a day's time is described as follows in the *Contract Record*, of Toronto.

The entire garage, with the exception of the concrete floor, which is cast on the ground, is constructed of pre-cast units, including slabs, pilasters, sills, plates, collar beams, rafters and other necessary pieces. Lightweight aggregate is used in the manufacture of these units in order to keep the weight down so that two men can easily lift and handle the largest pieces.

In building the garage the concrete floor is placed first. After this has hardened a pilaster 8ft. high is erected at the corner and a section of concrete sill placed. Then one of the slabs, which are 33in. wide, 8ft. long and 1in. thick, is put into place. The pilasters and sills are slotted so that the edges of the slabs will fit snugly into them. Next, an intermediate pilaster, slotted on two sides, is erected; another section of sill is laid and the second slab placed. This operation is kept up until the building wall is completed. Pre-cast plates similar to the sills are then fitted on the top of the wall. To prevent spreading opposite sides of the wall are tied together with pre-cast collar beams. These beams are bolted at the ends to the pilasters by means of bolts embedded in the pilasters at the time of manufacture. The roof, which is of slab construction, is supported by pre-cast concrete rafters 3ft. apart. The lower ends of the rafters rest on the pilasters and are bolted to them with the same bolt that passes through the collar beams.

Doors consist of concrete slabs cast in special steel frames which are provided with hinges so that the various sections will fold together. Bolts for the attachment of hinges are embedded in the concrete corner piers at the time of their manufacture.

Window sashes are also made of concrete and are glazed with wire glass panes. Special short length wall slabs are used above and below the windows. These are slotted on the ends next to the window so as to get a good tight joint. The sides of the sash fit into the slots in the pilasters.

No mortar is used anywhere in the construction of the garage, and, if at any time it is decided to move the building, it can be taken apart readily and the units transported to the new site and the garage rebuilt.

ROYAL SOCIETY OF ARTS.—The Peter Le Neve Foster Prize offered by the Society for an essay on "The Mineral Resources of China" has been awarded by the Council to Mr. Chung Yu Wang, M.A., M. Inst. M.E., &c., mining engineer, of Hankow, China. The prize consists of the sum of £10 and the Society's silver medal.

The Institute of Transport.

No. II.*

In the lecture theatre of the Institution of Civil Engineers, on the morning of Thursday, the 18th, Mr. Neville Chamberlain read a paper on "Inland Water Transport: A Practical Policy." In introducing the lecturer, the President, Sir Henry Maybury, said that in spite of great difficulties, financial and engineering, Mr. Chamberlain, with the energy characteristic of his family, returned to the cause of canals. In his opening remarks Mr. Chamberlain said that it might be thought that he was leading a forlorn hope. He did not want sympathy, as he thought he was advocating a very profitable source of transport. The following is a summary of the lecture.

INLAND WATER TRANSPORT.

It is unnecessary to go over familiar ground and to trace again the history of our inland waterways, but I may perhaps repeat one or two salient facts which dominate the situation as it exists to-day. In the whole network of canals and canalised rivers throughout the country there is not a single route connecting the central industrial districts with the sea, with the exception of the Manchester Ship Canal, which is in the hands of a single authority. Many of them are divided into a number of short sections, each under separate ownership, and something like one-third of the total length of the barge canals of the country is owned or controlled by their principal competitors.

There is no doubt that the very size and boldness of the 1906 Royal Commission's conceptions defeated their own ends by frightening off the Government and the public of the day. If that was the case in 1910, still less would such proposals be likely to command assent to-day. What we want is a new policy adapted to our times and likely to commend itself by its soundness and prudence to men of business. Such a policy, I believe, is to be found in the recommendations of the Departmental Committee on Inland Waterways, over which I have had the honour of presiding.

It is best to be perfectly candid in this matter. A policy of waterway improvement must be founded upon expectations of increased traffic, sufficient to give an adequate return for the capital expended. But there are no sufficient data in existence to enable anyone to make a reliable estimate of what that increase will be. There are too many unknown factors in the case and there is too little experience in the past to allow us to do more than guess at results; but I reach the following conclusions:—

Waterway improvement should proceed by steps, not all at once.

Each step must be to some extent an act of faith, but the data obtained as the result of each step will afford surer and more solid ground for the next advance.

For successful working I venture to lay down three conditions which must be fulfilled:—

(1) Central management and control of the water communications throughout the district comprising this group.

(2) Properly equipped terminal facilities with adequate "lay-by" space, handling apparatus, and warehouse accommodation.

(3) Regular and punctual services.

(1) involves the transferring of the railway-owned and controlled canals to the water group to which they belong. No doubt this would be welcomed by the railways.

(2) involves the expenditure of capital. Fortunately, the development of road transport in recent years has materially eased this problem.

(3) is essential. The absence of regular services has been one of the principal causes of the failure of canals to offer satisfaction to the trader, and the power at least of supplying them should be granted to those controlling the waterway.

The question here arises: What is to be the ownership and the nature of the management of a group. Personally, I should much prefer that the whole thing should be left in the hands of private enterprise, but I recognise that, to ensure success, a considerable amount of new capital must be sunk. It seems to me, however, that the whole burden cannot be placed upon private enterprise, but that there is a good case for inviting the co-operation of the principal local authorities interested and, following the continental practice, of the State itself.

What should be the first step in carrying out such a policy as has been briefly outlined above? My Committee have fixed upon the Trent Navigation as that which presents the most favourable field for experimental advance. Here improvements are actually being carried out by the Corporation of Nottingham in co-operation with the Trent Navigation Company and with assistance from the State under an unemployment relief scheme. When the works, of which a portion is now being executed, are completed, the Trent from Nottingham to the Humber will be an example of a good waterway and will thus present the first essential condition of success. A very few years should be sufficient to demonstrate the results which may be expected from the application of such methods, and I should anticipate that there would then be little difficulty in the formation of a second group. No doubt, in such a case, larger capital would be required to provide an efficient waterway; but if these two groups were both successful, the general application of the policy to the main groups of waterways would be certain and rapid.

Sir John Eaglesome, in opening the discussion, gave figures as to canal traffic to-day and pre-war. The decrease was entirely due to the increased cost of labour, which had made canals no longer a practical proposition for the small carrier. The Committee, of which Mr. Chamberlain was the chairman, had concentrated its attention on one scheme—the improvement of the Trent—as being the most economical and most promising. The ideal arrangement for termini was a kind of Trafford Park, where outwards traffic could be brought and whence inwards traffic could be delivered by motor vehicles. He thought the Ministry of Transport should take a deeper interest in canals, and that there should be someone representing that industry in the Ministry. Sir William Acworth said a great deal had been written and said on that subject, but Mr. Chamberlain had brought it down to a definite proposition. He entirely agreed with all the conditions the author had laid down, but he had to part company with him when it came to the question of making an experiment. There was no better place than the Trent to try it, but he could not see that the prospects were good enough. Sir William quoted the opinion of M. Cuenot, the well-known French writer on transport, who said that railways could convey traffic as cheap as, if not cheaper than, canals. It was proposed that our canal boats should be of 100 tons capacity, but M. Cuenot said that what was wanted was 600-ton boats; even 300-ton vessels were no good.

Mr. H. A. Watson said that one of the reasons why the railway was preferred to the canal was that it reached practically every destination for which there was traffic. If traffic was sent part-way by canal and thence by rail or road it meant transhipment. Experience with the new large works at Selby in which the late Lord Manton was interested showed that most of the raw material came by water from Hull, but the bulk of the manufactured article went by rail. Mr. Sydney Preston could not see the advantages of the 100-ton boat; he thought it better to improve the canals to take the present "monkey" boat of 30 to 35 tons, and to improve the locks so as to hold four of them at one time. There were ten to twelve thousand of these boats in existence. Sir Sam Fay spoke encouragingly of the prospects of the Sheffield and South Yorkshire Navigation now it was in private hands and not tied in its charges by law as is a railway company. To make any waterway scheme a success those responsible must be in charge from start to finish of the journey. Mr. Ross Johnson said they needed a clear lead as to finance. The 100-ton boat was not wanted; it would be better to do as suggested by Mr. Preston. Transhipment was something of a bogey; containers removed many of its evils. Colonel Rayner considered that the question of the 100-ton boat was one for the commercial manager and not for the engineer. He consulted the millers and others in the valley of the Trent, and found that the desired capacity was from 70 to 120 tons. All the works on the Trent Navigation were designed to pass a tug and a string of barges equal to four 100-ton boats. The locks were 190ft. long by 30ft. wide. They were aiming, on the Trent, to work in closest sympathy with all other means of transport. Road transport had been a great help to them.

In replying, Mr. Chamberlain said he wished people would think of inland waterways and not canals. One reason why a bigger boat was necessary was that the "monkey" boat could not go into the seaway. There might not be justification to spend forty millions now, but the experiment was worth trying on the Trent with half a million. That was being done, and soon we should see the result.

On Thursday a paper on "The Future Design of Road Vehicles" was presented by Sir John Thornycroft, from which the following passages are taken.

THE FUTURE DESIGN OF ROAD VEHICLES.

There is no very great difference in the design of steam vehicles in use to-day and those which led the way about twenty years ago. There are two fairly well-defined types, namely, those using a locomotive boiler and a fairly high-speed engine with more than one ratio of reduction gear available, and the other having a large slow-speed engine with a single reduction to the back axle and no change of gear, depending solely on later cut-off and increased pressure of steam in the cylinders to give the increased torque for ascending steep gradients. The latter arrangement has the advantage of simplicity, and by using superheated steam economical results are obtained. With neither type is any attempt made to condense the steam and the large quantity of water which is necessarily carried not only adds to the weight of the vehicle, but is often difficult to obtain. It will be generally agreed that the designers have probably done as much as is possible with a non-condensing vehicle of this type. If one expresses the fuel consumption per ton-mile in terms of heat units available in the fuel, it will be found that the average figures of the vehicles which ran in the Liverpool trials in 1901 were 18,350 B.Th.U. per gross ton-mile, and the present-day figures of the best types in general use show a consumption of about 17,600 B.Th.U. The internal combustion engined vehicles which competed in the 1901 trials showed up very favourably in comparison with the steam, averaging 33.6 ton-miles to the gallon of petrol, or, expressed in heat units, 3600 B.Th.U. per gross ton-mile. Average present-day consumptions taken at 10 or 15 per cent. less than the best recorded results show 2450 B.Th.U. per gross ton-mile, a really important advance and a figure which, for the internal combustion vehicle, is of great interest when compared with the corresponding figure of 17,600 B.Th.U. of the present-day steam vehicles and a further valuable comparison may be made by taking the consumption of the vehicle fitted with a suction gas producer, as in this case we have a direct comparison with a similar type of fuel used either to drive a steam engine or one working on the internal combustion principle, and while the thermal efficiency is not so good as with petrol as fuel, viz., about 4500 B.Th.U. per ton-mile, the fact that the efficiency is about four times greater is a very definite indication of the direction which development ought to take.

It is noteworthy that the designs of steam vehicles which have survived all employ a boiler holding a considerable volume of water. The flash boilers of the Serpollet type have entirely disappeared. The reserve of energy in the hot water in the boiler is a most valuable feature and one which the internal combustion motor vehicle does not possess.

An observed trial carried out under the supervision of the R.A.C. of a Clarkson vehicle, described as a "National coke fuel motor," in 1914, showed that about 6 lb. of coke per gross ton-mile was used. This is probably the best result shown in any officially recorded trial and is considerably better than the average figures for the steam wagons generally in use in the country to-day.

Petrol Motor Vehicles.—In considering the chances there are of any radical change, one would ask, is it probable with increasing loads that builders will adopt a drive on all four wheels? Where vehicles are intended to run on made roads, in the writer's opinion, the complication of driving on more than one pair of wheels would always be a bar to the adoption of the system. If we assume that the vehicle will continue to be driven by one axle, what are the most likely features to be modified? Running costs are largely made up of fuel consumption and maintenance. There is no reason why a highly efficient motor and gearing should not exist with a minimum maintenance cost and with the best designs it may be taken for granted that it does; but it is a very nice point for the designer so to proportion the parts of his mechanism that he does not make the size of the various parts of the mechanism so large, to reduce the stress and wear, that he unduly increases the weight of his machine and its consumption of fuel. The only alternative to the gear-box transmission which is meeting with any success for commercial vehicles seems to be the Stevens electric drive, consisting of a continuous-current generator driven direct from the motor and which, in turn, drives the axle by means of an electromotor coupled to it by a propeller shaft or other means.

With regard to the motor itself, designers are continuously working to obtain greater economy, not only of fuel, but of oil consumption. Probably every alternative valve position and gear has been tried, as well as various types of sleeve valve arrangement. The present record in this country is, however, held by what may be described as a well-designed normal type of motor with the inlet valve placed over the exhaust. In the hope of obtaining still better economy, on the Continent a number of engineers are working at engines with high compression and in some cases trying to use small motors of the pure Diesel type. If a small Diesel engine could be made with a considerable range of power and revolutions, it would, of course, be a great stride and not only most useful for motor vehicles, but for all sorts of other purposes; but experience with motors of this type ranging over a number of years does not make it seem at all probable that we shall have motors of this type fitted to lorries at an early date.

A short time ago it would have been looked upon as impossible to use cast aluminium road wheels, but they have been in service now with a number of vehicles with success for a considerable time. The extent to which the employment of aluminium will increase will no doubt depend to a great extent on the price at which it will be produced in comparison with cast iron and steel. Coupled to some extent with the employment of aluminium for various parts of the lorry will be, it is thought, the use of pneumatic instead of solid rubber tires. The relative advantages of solid *versus* pneumatic tires are difficult to decide. For passenger vehicles and lorries taking fairly heavy loads, with the present cost of pneumatic tires it seems very doubtful if they are worth while except in certain special cases. Unless road authorities decide that much less damage is caused by pneumatic tires and obtain legislation to support them, it does not seem probable that there will be any greatly extended use for the heavier class of vehicles, failing a great reduction in their first cost and the lessening of some of the other disadvantages.

It will be gathered from the foregoing remarks that until the physicists and chemists discover some new source of energy or means of storing it, the writer does not think it probable that there will be any great change in the design of present-day road vehicles, and that engineers will have to content themselves with devoting their attention to improving details of design with a view to getting the best possible economy out of the fuel available and making the machines as simple as possible to maintain.

Opening the discussion, Mr. R. J. Howley, member of the Council, agreed with Sir John Thornycroft that there did not seem to be much chance for some time to come of any big development save on the normal lines of the ordinary petrol chassis. He looked forward in the near future to a very big improvement in the use of steel. Great improvements had taken place in regard to the detail of vehicles, but there were still some points much open to criticism. He instanced the clutch on the large omnibuses in some of the big towns, which was not satisfactory. Its application, resulting in a leap forward of the vehicle, was a rough and uncouth means, and was open to much improvement. He recommended the petrol-electric drive, which to his mind had a great future.

Mr. A. Dryland, county surveyor of Middlesex, regretted that he did not find a great deal of comfort in the paper. The vehicles which damaged the roads damaged themselves, and he could not help thinking that the vehicle designer would have to pay more attention to the question of shock and the better distribution of absorption. Dealing with resiliency, the speaker said that he hoped to see the development of the pneumatic tire for traffic.

Mr. Shave, of the London General Omnibus Company, agreed with the last speaker that a good deal of improvement could be effected between the engine and the rear axle. Sir John had also mentioned unsprung weight, which was a very serious proposition. Everything should be done to reduce it to a minimum, and the tire certainly was the first question to be tackled. The pneumatic tire was, he feared, not likely to be adopted for the heavy type of vehicle, but he did believe they were very close to a suitable tire more resilient than the cushion type of tire, and one which could be used by heavy vehicles with aluminium wheels. His company had made tests of such wheels and tires for as many as 20,000 miles.

Lord Montagu of Beaulieu said there must be some co-operation between the road-maker and the designer and the user of motor vehicles. They had still the big type of vehicle on which between 35 and 40 tons were borne on no fewer than eight wheels. That was on the railway. In order to relieve the strain on the road and to carry loads which were commercially profitable they would have to put the load on more than four wheels. That was really the direction in which the designer should go, and he thought that most of them would see eye to eye in that direction. He did not see why even more than six wheels could not be employed. Referring to the use of gas suction plant, he was a firm believer in it, and he thought that the initial difficulty of the operation could be very easily got over. There was one other subject on which he would touch. It was the present system of taxation of motors. He thought it was a very bad system, because it encouraged tax-dodging and made it difficult for manufacturers in this country to export their products and encouraged from a mechanical point of view a bad type of engine.

Mr. Strickland said that he thought the steam vehicle was still capable of improvement. It had been assumed generally that the steam engine should not want a speed gear, or that if it did it only wanted two speeds. Personally, he did not agree with that view, and he thought that by the adoption of three speeds in steam vehicles they would be considerably improved.

Major Tulloch at this point submitted a model of a ten-wheel trolley designed for road traffic. The drive was on six wheels, he said, and the trolley could turn in two and a-half times its own length. Owing to the drive being on six wheels, the wear on tires

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was greatly reduced and the chances of skidding were very small.

Mr. W. Worby Beaumont was inclined to think that there was a greater future for the electrical battery vehicle than was suggested in the paper. In various things he had written since 1898 he had pointed out that motor expansion depended upon the road question. That had been more and more realised until now they got the whole country believing in having good roads.

In the evening of Thursday the third annual dinner was held at the Savoy Hotel. Ladies were, for the first time on such an occasion, admitted, and, assisted by a few short speeches and a good musical programme, a most enjoyable evening was spent. Sir Henry Maybury was in the chair, and responded to the toast of the evening, proposed by Mr. Edward Shortt, the Home Secretary. Mr. Arthur Watson was heartily cheered when he rose to propose "The Guests," to which Mr. Arthur Neal, Parliamentary Secretary to the Ministry of Transport, and Mr. Van Heyst, of the Dutch Road Commission, responded.

On Friday, under the chairmanship of Sir Sam Fay, a paper by Professor Carlier, of Liége University, was read. It bore the title "Foreign Railway Practice: New Features in Railway Traction Methods." The author was unable to be present, and the paper suffered also by his not being able, owing to its late arrival, to revise it. The first quarter of it was devoted to the Chicago, Milwaukee and St. Paul, and then followed a description of the Ramsay condensing turbine electric locomotive, described in THE ENGINEER of March 24th last. A summary of the remainder is as follows:—

FOREIGN RAILWAY PRACTICE.

Messrs. Krupp, of Essen, have taken a great interest in the construction of a Zoelly steam turbine locomotive with condensation.

An ordinary piston locomotive of the Schweizerischen Bundesbahnen has been converted into a steam turbine locomotive with condensation at the works of the A.G. Escher-Wyss and Co., at Zurich, and the Locomotiv-und Maschinenfabrik, at Winterthur. Many trial trips, after a good many alterations and improvements, have led to very good results. The two turbines, one of which for moving ahead, the other one for moving back, are arranged upon a common shaft, which is situated transverse to the machine axle in a case fixed on a frame in front of the smoke chamber. The driving force is transmitted on the back axle through a shaft with spur gearing. By means of driving and coupling rods the wheels are driven in the usual way.

The surface condenser is fixed underneath the boiler behind the turbines. The necessary reserve cooling water is placed on the tender, on which are also lodged the re-cooling plant and the coal. The re-cooling plant on the tender works as follows:—A revolving pump presses the cooling water through the condenser and from there into the re-cooler, which chiefly consists of a number of tubes arranged like an archway to a roof. The tubes, provided with a number of small holes, make the water pour forth in small jets, where—through the ardent touching with the air current, caused by the driving speed—it is re-cooled.

It seems that this engine, much simpler than the Ramsay's, cannot be compared with same as far as the condensing plant and economy are concerned. Indeed, it must be noticed that the Ramsay condenser is, as well as a condenser, a re-cooler, while in the Zoelly's system two different apparatuses are used, the one for condensing the exhaust steam, the other for cooling the circulating water of the surface condenser. This is a very important point.

Other locomotive builders are also undertaking the building of condensing locomotives. In Norway, for instance, a Ljungstrom turbine locomotive is under construction. In Italy the Company Officine Meccaniche has also built a small turbine locomotive. In Belgium the Société Cockerill is making drawings for the building of a condensing piston locomotive. Although the use of pistons may be criticised, the Société Cockerill is of opinion that it will be possible to get the grease out of the exhaust steam. At present the steam is expanded three times.

While it is certain that the efficiency of a turbine is higher than that of a three-expansion steam piston engine, it is also certain that the command of the driving wheels at different speeds by a turbine is rather difficult, unless by electricity.

Sulzer Frères, in Switzerland, built before the war for the Saxe Railways (La Saxe in Germany) two internal combustion locomotives, which have done very good service until lately. A new series of those engines it now under construction. The engine consists of a Diesel motor in "V" with four cylinders, the pistons of which are connected with a crank axle which is linked at each end by connecting-rods and winches to the two driving axles. The frame is supported by two bogies, one at each end. Between them are the four driving wheels. The weight of the engine is 95 tons.

At a speed of 102 kilom. per hour the Diesel motor revolves at 304 revolutions per minute, and its power then reaches 1600 horse-power. The weight per horse-power amounts then to 59.5 kilos., while, for a steam locomotive such as the "Pacifics" of the Belgian State Railway, the weight per horse-power is 62 kilos. The start must be made under compressed air, until the speed has reached about 10 kilom. per hour. Then begins the petrol injection and the compressed air supply is stopped.

A combined internal combustion electrical locomotive is now operating on the Minneapolis, St. Paul, Rochester and Dubuque Railway. On this line, which is an electrically operated one, a limited parlour-car train is run over a distance of 107 miles with four stops in 3 h. 25 min. The locomotive has two eight-cylinder 175 brake horse-power internal combustion engines, which are directly coupled to two 600-volts compound wound electric generators, the engines being started by compressed air taken from a large receiver used for the brakes.

Other examples of internal combustion motors on railways have been in existence, such as the Pieper, in use in Belgium and in France; the Strang system, used in the States; the Sulzer, used in Switzerland; and the Westinghouse, used in Austria.

Mr. Roger Smith, in opening the discussion, observed that during the present century the thermal efficiency of the steam turbine had been raised from 12 or 14 per cent. to 25 per cent. Owing to a consequent reduction in the size of boilers, engines, and the floor space, power stations to-day could be built at a pre-war total cost. Locomotive engineers in this country had not given the matter the same attention, but if the thermal efficiency of the steam locomotive were raised from the present figure of 6 per cent. to even 8 per cent., three million tons of coal a year would be saved to British railways. It was unfortunate that the Chicago, Milwaukee and St. Paul was used as an illustration, as there was nothing like it in Europe. He agreed with the author that electrification in Great Britain, France, and Belgium should save from 66 to 80 per cent. in the coal bill. After reciting some of the other economies possible, Mr. Roger Smith said that one electric locomotive could do the work of two steam locomotives. They were not double the price; only 50 to 75 per cent. more; and so, if the renewals of engines continues to be a revenue charge, there need be no capital expenditure on electric locomotives; only on power stations and line equipment. Mr. Kelway-Bamber said there was a great opportunity for making an advance in the amount to be pulled by the steam locomotive. There was little chance of advantage being taken of it because the terminal facilities were unsuitable for bigger wagons. Thousands of difficulties were raised against their use, and officers were up against a brick wall.

When the time arrived for Colonel Pringle's paper to be dealt with the reading room was inconveniently crowded, and it soon became evident that the meeting shared the views of the chairman, Sir Sam Fay, that it was a pity the whole morning had not been devoted to the Colonel's paper. We regret that our summary must be short. We have, however, endeavoured to give prominence to the most important part of the paper—that dealing with automatic train control and continuous brakes for freight trains—but this is at the cost of entirely cutting out what was said about accidents due to mechanical failures.

SAFETY IN RAILWAY OPERATION.

During the past three years the average number of collisions reported, in which passenger or goods trains, or both, were concerned was 250; of collisions with buffer stops, 42; and of collisions with level crossing gates, 235. In the same period derailments of trains and engines have averaged 480 in twelve months, whilst the number of cases of trains dividing reached the figure of 8876 in the year 1921.

Traffic conditions during the past thirty years have altered in many respects. Locomotives are twice the weight and haul trains of twice the length. Their boilers are longer and higher and more obstructive to a good view from the footplate. Speed maxima have increased with express passenger and goods trains, but not to the same extent with slower services. Higher frequency of traffic has necessitated the provision of further facilities for movement. Block sections have, therefore, been multiplied, whilst the areas controlled from individual block posts have been much extended by the addition of far-flung signals in both directions. Meanwhile, though much has been done to improve safety in operation, there are nowadays so many more occasions when there is possibility of danger that action to ensure continuous progress appears to be advisable.

ANALYSIS OF ACCIDENTS.

An examination of some 200 of the more serious accidents which have been fully reported upon during the past ten years has been made and forms the basis for a number of conclusions.

The first point to be noted from this analysis is that about 20 per cent. of the cases originated in failure of mechanism, equipment, &c., whilst 80 per cent. were directly due to failure of the human agent. It would appear, therefore, that there is greater need for additional safeguards against human than against mechanical failure.

Turning to the largest class of accident due to human failure, i.e., those which occur on railways with more than one line of way, the number of cases critically examined has been 148. These cover a wide range, and, for convenience, have been divided into three subheads:—

(a) Failures of signalmen	49	about 25 per cent. of the whole
(b) Failures of enginemen	65	about 33 per cent. of the whole
(c) Miscellaneous	34	about 16 per cent. of the whole
Total	148	

Failures of signalmen lie mainly in the direction of forgetfulness of the position of trains or vehicles shunted on to a running line; of neglect to observe that the lines within their control are clear of obstruction, or to utilise the information furnished by block instruments of the occupied or unoccupied conditions of the sections on either side; of thoughtless and over-hasty action in taking for granted—sometimes in times of pressure or in bad atmospheric conditions—that movements are complete and fouling points of junctions cleared before authorising conflicting traffic movements. The sovereign remedy against this generic class of failure is track circuiting, which provides an all-time automatic detection of vehicles in occupation of lines. Track circuit has the outstanding advantages that, for normal working, there is no occasion to provide signalmen with a means of release for the control exercised, and that the presence of any vehicles left behind in the protected area, owing to trains dividing or being forgotten in shunting operations, is continuously detected. It therefore forms a means of supplementing the observation by signalmen of tail lights, a duty of high importance, having regard to the increasing length of unfitted goods trains and the annual number of cases of trains dividing. Despite some difficulties and limitations, it is claimed that track circuit is one of the most valuable adjuncts to safety of railway operation. There can indeed be no doubt that the more completely lines of railway are track circuited, the higher is the factor of safety against failures of signalmen, and the greater is the protection against practically 20 per cent. of all train accidents.

The majority of accidents due to failure by enginemen are collisions caused by trains passing stop signals at danger, either owing to enginemen mistaking which road they were travelling upon, and consequently misreading signals, or failing to observe or correctly interpret them. Out of 65 accidents due to failure of enginemen, 36 are cases of this character. Up to the present there is no generally accepted practice of safeguarding these mistakes. But experience has shown, and continues to show, that there is no one more fruitful cause of accident. It is time, therefore, to recognise that protection against liability to accident arising from failures of enginemen is both natural and necessary in the interests of safety and railway operation, and that automatic train control is the only possible aid and preventive. The difficulty nowadays lies in the selection of a system from a plethora of devices invented for the purpose, and naturally also in finding the necessary funds.

Unfortunately, the standard block overlap remains practically the same, irrespective of the varying speed of trains, the effect of gradient, and the control available from the braking equipment. If a standard degree of braking equipment were provided on all trains the effect of gradient duly allowed for, and the overlap, fixed accordingly for the highest speed likely to be attained, practically complete security against accident due to occasional failure of enginemen to obey signal indications could be obtained by equipping locomotives and stop signals with a comparatively simple train-stop device. Though it might be possible to arrange for the overlap to be increased where necessary, by alteration in the position of or addition existing signals, the lack of a continuous brake upon goods trains necessitates a much more elaborate and costly system of automatic control if adequate security against failure of enginemen is sought.

A few cases of derailments due to excessive speed on curves do not appear to justify the inclusion of apparatus for controlling speed as part of the scheme of a necessary system of automatic train control. Moreover, in view of the great variations in the maxima of speed worked to on British railways, of the fact that locomotives are used for both passenger and goods services, and of the different degree of brake equipment upon passenger, mixed, and goods trains, serious difficulties would arise from the use of speed control.

A comparatively common type of accident is collision with buffer stops. Speed control has again been advocated as a remedy for cases of this description. But critical examination of accidents of this type which are not due to interruption of the continuous brake shows that the speed at the moment of collision is practically in all cases very low, i.e., between two and five miles an hour. It is more than doubtful whether such nicety of brake effect, even were an intricate and costly system of speed control or time element relay provided, could be thereby assured to prevent accident, and at the same time permit station roads to be used to their full capacity.

Signals are misread, or misunderstandings arise between an engineman and fireman, owing to the difficulty which is experienced, on sharply curved platform lines and at trailing junctions between platform and through roads, in placing signal semaphore arms and lamps vertically over the roads concerned. At such places colour light signals can be used with advantage to safety, as well as to economy, wherever electricity is available as an illuminant.

After reference to miscellaneous failures, 16 per cent., the paper proceeds to say that the general conclusion drawn from the analysis of the 200 accidents during the past ten years is that preventive or beneficial effect would have resulted by means of:—

	Per cent. of the cases.
Automatic train control	33
Track circuiting	20
Continuous brakes upon goods trains	10
Better methods of working or equipment, &c.	10
By greater care and precaution on the part of *personnel*	17
	90
Leaving a number of cases which may reasonably be described as unpreventable	10
	100

The beneficial effect likely to be exercised upon safety in railway operation by the use of continuous brakes upon goods trains cannot be appreciated without taking into consideration other statistics than those furnished by an examination of the accidents officially inquired into. It has been mentioned that in the year 1921 there were 8876 cases of trains dividing. Of these, 6354 were concerned with goods trains and 2522 with passenger trains. The accidents resulting from these cases of division were 50 and 5 respectively. The liability to accident from division appears, therefore, to be four times as great in the case of unfitted trains. It is estimated that in the 50 cases of accident due to goods trains dividing, more than half would have been prevented by use of a continuous brake. A number of level crossing accidents also yearly result from difficulties experienced in controlling or by misjudgment of braking effect upon unfitted trains. These would also be prevented by use of a continuous brake. Apart altogether from the increased capacity upon lines of railway which would result from the use of continuous brakes upon goods trains, it may be noted that the cost of introducing an acceptable system of automatic train control will be approximately doubled by the fact that the large majority of goods trains are unfitted with a continuous brake.

In the discussion which followed the paper, Mr. C. J. Selway considered that the questions of automatic train control and of continuous brakes for freight trains were hedged about by financial problems. If the coupling and uncoupling of wagons could not be done with the same facilities as now the disadvantages of continuous brakes would outweigh the benefits. It was, too, a question as to how far the provision of safety equipment, which would reduce the necessity for human efficiency, should be enforced. Mr. J. P. Thomas, alluding to a remark in the paper as to the instantaneous removal of electrical pressure on tube railways, where failure of insulation might result in arcing, said that that had now been done on the Underground lines. Mr. W. J. Thorrowgood compared the number of accidents with the number of train movements—therewere, on an average, ten movements made by a signalman at each signal-box a train passed. Mr. A. F. Bound considered that if automatic train control had to wait for the freight trains to be fitted with continuous brakes, the work would be postponed indefinitely. Mr. F. V. Russell reminded the meeting that freight trains with continuous brakes could get over the line more quickly, and in many cases a double line might then do the work now done by four lines.

The chairman, Sir Sam Fay, said that many problems would have to be faced before continuous brakes were fitted to freight trains. Finance was one, but that would be more easily overcome when the railways were grouped. Sir Sam had had some experience with automatic signalling, and considered it paid well. He knew of a case where a reduction of 20 per cent. in wages was made. Colonel Pringle, in replying, agreed that automatic train control and continuous brakes for freight trains were financial questions, but there were advantages to be gained from them. The former would dispense with fog-men and so save hundreds of thousands a year. Then there was the compensation payable for accidents.

In the evening, at the Royal Society of Arts, a paper on the operation of heavy suburban passenger services was read by Mr. F. V. Russell. It was announced as being for the students of the Institute, but was well attended by all grades.

We are obliged to hold over the reports on two papers—one by Colonel Bressey, read on Thursday, and the other by Mr. Dixon Davies, presented on Friday—till next week.

In conclusion, we must mention that each day, and on Saturday also, visits were paid to many places of interest in the Metropolis and its vicinity, and that in every way the Congress was a real success.

Railway Matters.

THE underground companies have now thirty-three additional cars in use, an increase of about 3 per cent., although the traffic has decreased by approximately 5 per cent.

THE railway companies have no intention of restoring the "to-pay" arrangements for parcels traffic. To do this, they say, would require a considerable addition to the staff, as book-keeping would become necessary.

THE North-Eastern Company's works manager at Gateshead, Mr. R. A. Copperthwaite, has moved to Darlington to succeed the late Mr. Lockyer, and Mr. F. W. Carr, the assistant works manager at Darlington, succeeds Mr. Copperthwaite at Gateshead.

ON the subject of the unification of the railway gauges in Australia, Mr. Hughes, the Federal Prime Minister, said recently that he would cheerfully cease his advocacy for a standard gauge if those who were opposed to it would travel from Perth to Brisbane several times a year.

THE fireman who was so seriously injured in the locomotive failure of January 10th last at East Horndon, on the Tilbury section of the Midland Railway, has sufficiently recovered as to be able to give evidence at the adjourned coroner's inquest on Saturday last on the unfortunate driver. A verdict of "Accidental death" was returned.

FIVE of the thirty millions to be paid at the end of 1921 and 1922 under the Railways Act are for those companies which "are able to show that they have suffered abnormally by the standardisation of rates of pay, hours of duty and other conditions of service." The Railway Companies' Association and the Association of Smaller Railways have agreed to a scheme for the distribution of this sum, and it came before the Railway Amalgamation Tribunal on the 15th instant, and was approved.

THE London and North-Western Railway Company has honoured the three men in its employ who gained the Victoria Cross during the war by naming three of the latest and most powerful locomotives after them. One has been named after Private Ernest Sykes, V.C., of Mossley, who is employed as ticket collector at the Stalybridge Joint Station. He gained the V.C. while serving with the Northumberland Fusiliers near Arras by bringing in wounded under heavy machine-gun and rifle fire.

ONE of the subjects discussed at all the recent railway annual meetings was the application of the corporation profits tax to railways. When this tax was introduced, railways were exempted for three years, because they were at that time controlled by the State, and, when the control ceased, would be disorganised financially for some time. The period of exemption expires at the end of this year, but the Chancellor of the Exchequer, in his Budget speech, intimated that it would be continued for a further three years.

A QUESTION asked recently of the Parliamentary Secretary to the Ministry of Transport suggested that the London, Brighton and South Coast Company's passenger train services, both inward and outward, between Hove, Brighton, Hastings, and Eastbourne and London had of late been subjected to frequent and prolonged delays. Mr. Neal, in reply, said that his information was that these services had been running very punctually except for slight delays about March 8th, due to some telegraph wires having been blown down in a gale on that date.

SPEAKING on the 9th instant at the Railway Benevolent Institution dinner, Mr. J. H. Thomas said that at the very best railway amalgamations were a gamble, and no one could say how they were going to turn out. The only certainty was that the railways must not be run merely for the shareholders. Labour could not be treated merely as a marketable commodity to be bought or sold. Labour must realise that if it wanted good wages and conditions it must obtain them by making the maximum effort. That was the spirit in which the unions were going to work. At the present time the relationship between the companies and their servants was most satisfactory.

BY the Railway Fires Act, 1905—5 Edward VII. c. 11—railway companies are liable up to £100 for loss from fires caused by locomotive sparks, even if no negligence be proved. A Bill has recently been read a second time in the House of Commons for increasing the limit to £200, as the value of produce was double what it was in 1905. Speaking against the Bill, Sir Frederick Banbury said that last year, owing to the drought, 478 claims were settled by the Great Northern. Of these, 335 were under £25, 70 were between £25 and £50, 34 were between £50 and £75, and 14 over £75 and under £100. Only 5 per cent. were over £100. The Bill was subsequently read a second time without division.

THE Government of Ontario is proposing to complete the contemplated 70-mile extension of the Toronto and Northern Ontario railway from Cochrane, on the National Transcontinental line, to Tin Can Portage, by the end of 1923. Forty-seven miles will be built this year, and tracklaying is to begin next month. When the whole 70-mile extension is completed the Ontario Government may then consider the advisability of constructing the line to James Bay. The policy of the Provincial Government, however, is to extend the railways as the settlement and development of the contiguous counties progress. The present extension penetrates a territory excellent for farming, abundantly rich in lumber products and unharnessed water power.

LITTLE has been heard of late of the Severn barrage scheme. Mr. Neal, of the Ministry of Transport, was, however, recently asked a question about it, to which he replied that the Water Power Resources Committee considered the subject of tidal power, and expressed the view that the technical information available in regard to the possibility of utilising the tides in the Severn for the generation of power was not sufficiently precise to enable it to express a final opinion. The Committee recommended that a technical commission should be set up by the Board of Trade, in consultation with the Ministry of Transport, to investigate the possibility from a commercial standpoint with special reference to the Severn Estuary. The proposed commission has not, however, been set up.

Notes and Memoranda.

THE merchants of Soochow, China, have raised 5,000,000 dollars for the purposes of building a road for motor traffic between Soochow and Kashing.

THE hottest region of the world is, according to the United States Department of Agriculture, in California. The average maximum temperature in Death Valley since 1911 has been 125 deg. Fah., and the temperature once rose to 134 deg. The valley is from 178ft. to 337ft. below sea level.

THE total production of pig iron in Canada during March was 41,733 tons, as compared with 33,572 tons in February. The output of steel ingots and castings was 29,941 tons, as against 42,388 tons produced in the preceding month. At the end of March there were only three furnaces in blast, seventeen being idle.

IN replying to the discussion of a paper on the toughness of steel, given to the Birmingham Metallurgical Society, Mr. J. C. W. Humfrey said that the toughness he had in mind was capability of resisting tearing. If a material would tear easily it was brittle; if it tore slowly and offered a strong resistance to tearing it was tough.

THE manganese ore deposits of West Africa are, according to Mr. E. Davis, more accessible from England than any others of the world. The distance from the mines to salt water is only 35 miles, while Indian ore has to be railed 600 miles to the nearest port. The West African ore contains about 50 per cent. of manganese and from 0.1 to 0.12 per cent. of phosphorus.

THE existence in Chile of immense iron ore deposits of between 60 and 70 per cent. is well known. The Bethlehem Steel Company, which has for some years been paying a rent of 300,000 dols. (American) per annum for certain deposits, situated in the North of Chile, is stated now to have ready the several ships of 20,000 tons, which it has been building for conveying 3,000,000 tons of ore per annum to the United States.

A WATER tank of 40,000 gallons capacity, supported on a steel tower, 80ft. high, was built in Texas in 1910. When the steelwork was repainted the old paint and rust was not removed, so rusting proceeded at an aggravated rate until some of the lattice bars rusted right through. The tank was put out of commission, but was recently refilled accidentally, with the result that it collapsed in a heap. Fortunately no one was injured.

FIRES in zinc dust sometimes give particular trouble, owing to their resistance to extinguishing, and the liability of explosions. Tests made by the American Bureau of Mines on commercial zinc dust with various extinguishers, showed that water aggravated the fire and increased the danger, as did sodium bicarbonate solution. Carbon tetrachloride and silicon tetrachloride produced dense smoke. A frothy mixture was the best, smothering the flame quietly and effectively.

A NOVEL system of timing photographic exposures is described in a communication to the *Journal* of the Franklin Institute by Mr. P. P. Quayle. It was desired to take instantaneous photographs of bullets in flight, and the sound wave produced by the bullet was used to time the spark which made the exposure. The wave deflected the diaphragm of a device which completed the circuit of a static machine that produced the spark. By these means the flight of the bullet was not interfered with, as is the case if a wire or screen is used to time the spark.

FOR arc welding on sheets below ¼in. thick, it is best, according to some remarks made by Mr. A. L. Price, when lecturing before the American Welding Society, to use a metallic electrode. For thicker plates, however, he recommends carbon electrodes. Welding may be performed much more rapidly, he said, with carbon electrodes, although the joint produced is not quite as strong as that obtained with metallic electrodes. Under favourable conditions in both cases, the speed of welding a seam is about 4ft. per hour when using a metallic electrode, and about 15ft. per hour when using a carbon electrode.

WRITING on the subject of seasoning grey iron castings in the *English Mechanic*, Mr. W. J. May says that very many of the quickly produced machine tools used during the war and now scrapped for faults caused by unseasoned cast metal parts used in their construction, would pay to use as new material for the construction of other tools of a like character, after being again machined true, this being due to the fact that the metal has been seasoned and thus become free from movement; but, of course, much of the war surplus machinery is only mere scrap on account of the way in which it has been knocked about.

LINSEED oil is the basis of a series of products lately patented by German chemists, and described in the *Chemical Trades' Journal*. The oil is heated three or four hours to 110 deg. to 120 deg. Cent., in contact with finely divided iron, magnesium, or other metal, and is thus changed to an easily moulded solid. The properties vary with the time and degree of heating and the degree of exposure to the air. The material is soluble in such liquids as carbon bisulphide and benzol, is hardened by sulphur, and is unaffected by acids and alkalies. With the addition of anthracene or steatite, it becomes a rubber-like product suitable for insulation, linoleum and many other purposes.

IN the "Scientific Proceedings" of the Royal Dublin Society, Professor J. Joly describes a method of gauging the flow of rivers somewhat on the same lines as the method involving the addition of salt solutions, but giving even more accurate results and being very economical in labour and money. Radio-active measurements can be made with great accuracy by a simple form of electroscope. In the place of salt, which has to be introduced into the river by the hundredweight, a few litres of a solution containing a trace of radium is sufficient. Professor Joly proposes to use pitchblende dissolved in nitric acid and then diluted with water. The solution is fed into the river under constant pressure. The water samples, when collected lower down the stream, are conveyed back to the laboratory and stored in ordinary boiling flasks for ten or twelve days. The emanation is then boiled off into a small exhausted bulb, from which it is introduced into the electroscope. At the end of three hours the electroscope is read and the river discharge can then be deduced.

Miscellanea.

SOME concrete barges, which have been lying idle in the Tyne since they were built during the war, are to be used for bringing coal to London.

THE new coal pit at Harworth, Nottinghamshire, is to be equipped with electric winders, and it is intended to raise 2000 tons of coal per shift from a depth of 3000ft.

PLANT to deal with low-grade copper ore is to be put up by the Disputada and Demasias companies of Chile, and an overhead ropeway erected to convey the ore to the smelter. It is expected that the scheme will cost about £100,000.

THE blast-furnace of the Ford Motor Company at River Rouge, Mich., near Detroit, U.S.A., produced 18,807 gross tons of basic iron in March, averaging 606.6 tons per day. This is the largest month's output for this furnace. The consumption of coke was on the average 1797 lb. per ton of pig iron.

THE vein of silver ore recently discovered at Keno Hill, Dawson, yields, according to *Canada*, as much as 500 oz. per ton on the average, and has a width of from 3ft. to 6ft. A strike of free milling gold assaying 3000 dols. to a ton, has been made on Texada Island, in the Gulf of Georgia, British Columbia. The vein discovered is 1500ft. long.

THE Council of the South Wales Institute of Engineers has decided to hold an Engineering Exhibition at the Drill Hall, Cardiff, during the week commencing November 20th. The exhibits will cover scientific measuring and recording instruments, steam, electrical, and mechanical appliances, together with machine tools, and mining requisites.

DURING manœuvres by the German fleet on Tuesday night last, a collision occurred near Sassnitz between the warship Hannover and the torpedo-boat S 18. The latter was damaged, and ten sailors were killed. The S 18, which was afterwards taken to Sassnitz, is one of the newest German torpedo-boats, and carries a complement of ninety-one.

THE Electricity Commissioners have decided not to make regulations as to type of current, frequency and pressure, under Section 11 of the Electricity (Supply) Act, 1919, in the case of private generating stations having an installed capacity not exceeding 50 kilowatts. No notification need be made to the Commissioners regarding the establishment of such stations.

DURING the first quarter of the current year, 566 men were killed at coal mines of the United States, as compared with 494 during the corresponding quarter last year, an increase of 72 fatalities, or more than 14 per cent. The output of coal for the same periods was 150,923,000 tons and 124,030,000 tons, respectively, an increase in 1922 of about 22 per cent. The increased production has resulted in a decline in the fatality rate per million tons mined from 3.98 in 1921 to 3.75 in 1922.

ALTHOUGH only a few local ships use oil fuel, the facilities for oil fueling which have now been provided at the South Dock, Sunderland, by the River Wear Commissioners, will, it is hoped, result in additional vessels being attracted to the port. The Hugh Laing warehouse has been allocated to the purpose, and work involving the dredging of 10,000 tons of rock has been completed to provide a quay at which vessels with draughts up to 25ft. can be accommodated. The Anglo-American, the British Petroleum, and the Shell companies have tanks connected to the dock.

THERE is ample evidence, according to the monthly review of the London and River Plate Bank, that Argentina is likely to experience an oil boom in the course of the present year, the interests now active in the south being both numerous and important. Ten new tanks, having a total capacity of 80,000 tons, are in course of erection in Buenos Aires for the storage of Government oil, and the tank steamers are being gradually prepared to cope with the increasing passenger traffic which has recently arisen owing to the need for frequent and rapid communication with Patagonia.

SOME of the newer coalfields, such as Mailef and Los Lagos, in the Valdivia area of Chile, have been worked on an increasing scale during the past summer, but until proper methods of transport replace the ox-carts at present in use, these mines cannot develop into important producing centres. The Mafil Colliery is undertaking the extension of its light railway in the direction of Putabla on the Pichoi River. The tree trunks, which in part obstruct this stream, are also being removed. When this work had been done, coal can be delivered by barge to the Port of Corral, adding one more to the bunkering ports on this coast.

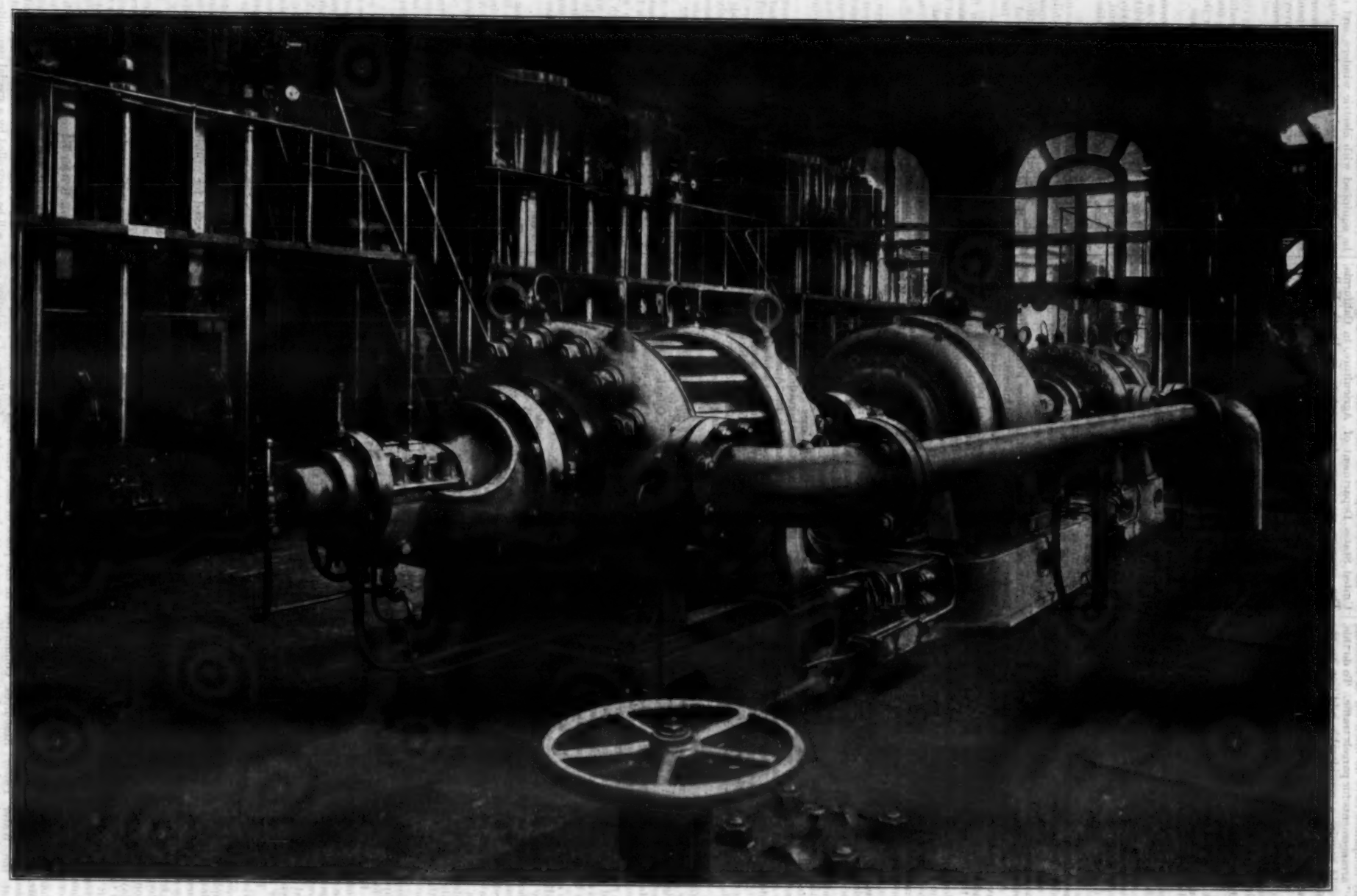
A LARGE power plant is being erected to utilise waterfalls within 30 miles of Santiago. Distributing stations will be erected for utilising the power over a large radius round Santiago, and beyond lighting the capital and running its tram service, the contract has already been secured for running the first zone of the State Railway between Santiago and Valparaiso, the electrification of which is now being commenced. Other contracts likely to be secured are the running of the Transandine Railway, shortly to be electrified, Valparaiso Port Works, and a large number of industries in the zone covered by the distributing stations.

THE British Engineers' Association has been entrusted with the task of organising the shipbuilding, marine, mechanical, and general engineering section of the British Empire Exhibition, to be held in London in 1924. The work of organising this section and allotting space therein will be controlled by a special committee, composed of the President and Council of the Association, and a number of independent representatives of the engineering industry. Within the limits of the space available—about 238,000 square feet—every effort will be exerted to make the engineering exhibits representative of all that is best in modern British practice. Full particulars, plans, and forms of application for space will be available for issue at an early date. Inquiries should be addressed to Mr. D. A. Bremner, director, the British Engineers' Association, 32, Victoria-street, London, S.W. 1.

ELECTRICALLY-DRIVEN HIGH PRESSURE CENTRIFUGAL PUMPING SET

HOLDEN & BROOKE, AND METROPOLITAN VICKERS, ENGINEERS

(*For description see page 59*)



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DEATH.

On the 24th May, at a Nursing Home in London, Lewis Henry Ransome, of Farndon, Newark-on-Trent, aged 59. Funeral Newark Cemetery, Saturday afternoon next.

THE ENGINEER.

MAY 26, 1922.

Chinese Markets.

It is hardly more than the dry truth to say that all Western eyes are on China at the present time. Germany, Great Britain and America are all seeking occasion to increase their markets and to find a field for activities which have outrun the capacity of existing purchasers. With a vast area and a huge population; with untapped mineral resources, antique methods of agriculture and manufacture; with opportunities for railways, tramways, for waterways and for docks and harbour works, irrigation works, and all means of communication, China presents possibilities for the Western manufacturer which he is determined to develop. Step by step, under the pressure of the West, China must surrender her old civilisation and take up the new, and until such time as, like Japan, she becomes herself an industrial nation, she must continue to barter for railway and shipping materials, for agricultural appliances of all kinds, and for the machines of the factory and the workshop, her tea and her silk, and all those Eastern things that the West takes for its pleasure or its comfort. For a century to come she must remain one of the greatest, possibly the greatest, purchaser of the products of engineering industries. There is, literally, no class of machinery that she will not want in large quantities, and, as a consequence, there are no people more interested in her development than engineers.

Despite the fact that China possesses such unimaginable possibilities for engineering developments, it must be admitted that British engineers have hitherto shown but a lukewarm interest in her development. It would be unfair to say that they are apathetic or supine; the truth is, rather, that they have taken more interest in countries that are both nearer and easier to understand and that could be "worked" at less expense than China. That course was defensible when, as a rule, a sufficiency of orders could be found to keep British factories employed, but to-day matters are very different, and it is imperative that British engineers should secure at once a large share of the Chinese engineering market. With a view to helping them we have recently appointed a number of correspondents in China in whose letters may be found useful hints about trade openings. But we had more in view. We hope our correspondents will succeed in "creating an atmosphere." It seems to us most important that our manufacturing engineers and merchants should get into the habit of thinking about China, and that we should do good if we could make them familiar with its problems. Hence we have encouraged our correspondents to write about all sorts of things occurring in that country. Once our manufacturers have overcome their shyness about a new and remote land they will, we are convinced, scrape up the courage to risk the expense of sending a representative out to see it and report upon its possibilities. That is the first step towards the opening of new markets. Everyone is agreed that direct representation is best, but it is costly; two or three thousand pounds a year are soon spent, and it is hard sometimes to justify such expenditure. Then the alternative, an agent, or a representative for several firms, has to be adopted. It is not so good, but it is better than doing nothing. Whichever plan is followed, one trouble is certain to arise. The Chinaman is not, with rare exceptions, a capitalist. Much as he may want to buy the goods, he cannot afford them, and the British agent or representative is usually instructed in such circumstances to refuse the order. The Germans take a different course, the same course they found so profitable in South America. They do not bother about early payment; a two years' credit with them is common. The Chinaman carries into his business the principle he is alleged to pursue with his physician: "No cure, no pay." If he is offered a crane or a thrashing machine and is assured by the agent in the familiar phrase that it will pay for itself in three years, he says: "Very well; when it has paid for itself I will pay you." It is difficult to conduct business on these matter-of-fact lines, and the Germans could not do it were they not supported by their industrial banks and by the alliance of manufacturing concerns with financial houses. It seems more than ever necessary that we should devise something of the same kind. A powerful financial corporation to finance British engineering manufacturers would make it much easier to do business with China than it now is. Years ago an effort was made by the British Engineers' Association to establish a corporation of the kind. It failed, but we suggest that a revival of the scheme by some one or other is desirable. All our large existing banks are already fully employed, and in any case the handling of big credits is opposed to British banking principles. A wealthy corporation moulded somewhat on the lines of the Handelsbanks appears to be called for. It must ever be remembered that we have now in China very active competitors in the Americans, and in a lesser degree in the Germans, to say nothing of the Japanese. We have either to meet these competitors or see the prospects that are presented by the development of railways, waterways, mines and agriculture, and the illimitable possibilities of electrical progress in all its forms, slip through our hands.

To look into the future is always an attractive pastime, and to this power of prevision, together with that of imagination and grasp of detail, the British Empire owes no little of its greatness. Clive in India, Raffles and Brooke in Eastern waters, Cecil Rhodes in Africa, are only a few of the great band of seers. To lift only the hem of the curtain which shrouds the development of China is to perceive that the essential of life is food, and that without food huge populations must at varying periods suffer from famine. To produce more food is therefore an essential to China, and to produce she must irrigate. China is well served with great rivers down whose channels millions of tons of water roll to the sea. The water supply is there; it is for the engineer to use it. Given a plentiful and safe food supply, industry, both agricultural and productive, will, in course of time, take root and flourish. That new era is opening. The engineer has already taken the first steps. Little by little he is teaching the Chinese to appreciate and need his help. Year after year China will require more and more of the products of engineering factories. She is ready and anxious to deal with Great Britain; but Great Britain must show an equal anxiety to deal with her. Courage and enterprise are called for, and where they are forthcoming a rich reward will be reaped. Other markets are slipping from us. India, Australia, South Africa, Japan are all now supplying in greater or less measure their own needs for machinery. China is still far from being in a position to do so, and owing to her vast area and immense population she presents a field for development unequalled in the world of to-day. It is for British engineers to see that advantage is taken of the

opportunities she presents, and that the value of the markets lost in other lands is more than replaced by our trade with China.

Safety in Railway Operation.

THE railways, as Sir Sam Fay remarked, came into their own on the last day of the Institute of Transport Congress. Two papers were then read and discussed, and it is a thousand pities that the whole morning was not devoted to the second of them—that on "Safety in Railway Operation," by Colonel Pringle, the Chief Inspecting Officer of Railways. It must now be many years since we had a paper of this sort from anyone holding such an authoritative public position. The "Proceedings" of the Institution of Civil Engineers and those of other learned bodies, *e.g.*, the British Association, show that former inspecting officers and departmental chiefs of the Board of Trade held forth, from time to time, in the 'sixties and 'seventies on the iniquities of the railway companies and their apparent indifference to the safety of their patrons and to the dangers run by their servants. Colonel Pringle's paper is a very different document; it not only has not a single word of blame for the companies, but concludes by saying that the responsible officers of British railways deserve the greatest credit for the high degree of immunity from accident that obtains in this country.

The paper might be described as having for its purpose the indication of the fact that no longer are accidents caused by the absence of the block system; by inadequate signalling or by the want of continuous brakes on passenger trains. All these safeguards are now provided and have been in use for the last thirty years. But, as the paper shows, there still are many collisions and derailments. For the last three years the average number of collisions is 250, and last year there were 480 derailments. Of these and other train accidents, 20 per cent. were due to failures of mechanism or equipment, and the remaining 80 per cent. to failure of the human agent. Thus we come back to the arguments advanced in our leading article of October 14th last on "Foolproof Signalling," viz., that however perfect the machine be made, the man behind the machine, being human and therefore frail, is liable to err, and thus to counteract the benefits of the mechanism. On the other hand, as we also pointed out, a machine destroys the initiative of the man and impairs his sense of responsibility. We have the block system, which should keep trains a safe distance apart, and we have signals which should protect trains standing foul, and yet we have collisions, and, although we have continuous brakes for passenger trains, drivers fail to pull up in time. This is difficult to explain. Colonel Pringle says that there are nowadays so many more occasions where there is a possibility of danger, because, among other things, the boilers of present-day locomotives are more obstructive to a good view from the footplate; the speed of express passenger and goods trains has been increased; and, to get greater capacity of the line, signals are far-flung from signal-boxes. Our researches suggest the truth of this explanation. Twenty years ago there were, during a three-year period, eighty-four collisions a year in which passenger trains were concerned, and the last three years have produced an average of eighty collisions a year. There were then sixty-three passenger train derailments; now there are eighty-eight. What makes this difference the more remarkable is that there has been a reduction of 5 per cent. in the train mileage. We can hardly credit that matters are as represented, but there the figures are. On consideration we suggest as an explanation that the companies are more particular now about reporting their accidents, and, because of their then less serious consequence, what was formerly regarded as trivial is now considered of such importance that it must be reported. We agree with Colonel Pringle that the present-day lower list of casualties to passengers is probably fortuitous, but we may reasonably claim this fact as, in part, corroborating our suggestion. Moreover, as the paper indicates, the recommendations in the accident reports of to-day are, compared with those of former years, of a minor character. Perhaps of greater importance than the compliment with which Colonel Pringle closes is the fact that his paper prepares us for a recommendation by the Departmental Committee over which he presides, that automatic train control shall be adopted. This, he says, is the only possible aid and preventative against drivers passing signals at danger, and it would have prevented 33 per cent. of the accidents due to the failure of the human agent. The paper names two prominent features which have a direct bearing upon the description of control required:—(1) The overlap, and (2) the provision of continuous brakes on freight trains. The feature (1), let us explain, is the length of what may be called the over-run or distance that a train may be given in which to pull up before reaching the danger point. This length differs at most stations owing to the gradient, but also differs between stations, having similar gradients, because it has to suit the varying speeds and weights of trains and of their braking power. If it be conceded that the difficulties of speed and weight are surmountable, there yet remains the question of braking power, particularly as regards freight trains. That difficulty brings another in its wake, as to which we shall say something in a moment. We first desire to add that it is certain that automatic train control, even when these features have been solved, will have many varying conditions to meet. In the discussion which followed the reading of his paper, Colonel Pringle said it would save fog-signalmen. That remark indicates that an intimation will be given to a driver as to the state of the signals he is approaching. To do that effectually, there must be continuous indications, so as to tell the man when a signal is changed from "danger" to "clear," and of equal, or perhaps greater, importance, should it be changed from "clear" to "danger." It must provide for conditions similar to those at Dawlish last September and Birmingham in December, where the drivers had a full knowledge of what they had to do, but failed at the last moment to take the final action in time. In the Birmingham case, it may be added, three passengers were killed. It must cover such a case as that at Selby last August, where a driver started from "dead" against his signals, whilst recently Major Hall implied in his report on the collision of February 6th in Summit Tunnel, where some signals were frozen in the "off" position, that train control also must come into play should the levers in the signal-box be normal and their signals giving an incorrect "clear" indication.

The problem of continuous brakes for freight trains must, however, be solved before automatic train control can be accepted as a full remedy against drivers passing signals at "danger." To have control on passenger trains alone is only half meeting the case. But before freight trains generally can have continuous brakes, other hard nuts will have to be cracked. Mr. Selway, the general superintendent of the Great Northern Railway, said that if coupling and uncoupling could not be done with the same facility as now, the benefits the brake gave in quicker running would be negatived. Another speaker said that screw couplings—and, consequently, the customary three-link couplings—would be no good; there must be automatic couplings. If that be so, then it, in turn, means the reconstruction of wagons generally, so as to put the strength along the centre of the wagon, and not, as now, behind the side buffers. Above all is the problem of the privately owned wagons, which form over 45 per cent. of the total wagon stock. Who is to pay for their equipment with the brake or with automatic couplings? It will be difficult to compel the trader to do so, whilst for the railways to buy up those wagons and to do it themselves means an expenditure of about fifty millions on their purchase alone. Furthermore, we have the information, given by a speaker from India, who has been studying American methods, and confirmed by Sir Sam Fay, that American railway officers and traders in the New England states are finding that their wagons are too big, and that they want a wagon more after the British type. This fact suggests that the much-advocated big wagon for our railways may be a mistake, and therein lies another possible excuse for delaying the standard wagon question, and consequently the provision of continuous brakes for freight trains. However, as matters are just now, there is no money, and the whole question is one of finance; it certainly is not one of engineering.

Modifications of Gas Quality.

FROM previous remarks which have been made in these columns, our readers will be more or less familiar with the principles involved in the Gas Regulation Act of 1920, and the conspicuous modifications in the methods of purveying towns' gas which have resulted from the operation of the Act. Briefly, it may be recalled that the gas undertakings now sell their gas on the basis of "therms," in lieu of thousands of cubic feet, that the heating value of the gas must conform with the "declared calorific value"—which the undertakings are permitted to choose for themselves—and that penalties in the way of fines are incurred if the official testing authorities have reason to believe that the quality falls short of that which has been declared.

The metropolitan area, which is served by three large gas undertakings, was one of the first to put the new principles into operation, and originally the "declared values" adopted were 475 B.Th.U. per cubic foot in districts north of the Thames, and 550 B.Th.U. south of the river. As the general public now pays for British thermal units, it is as well for it to be acquainted with the quality of gas with which it is supplied, for the gas meter to-day gives no real indication of whether one is receiving correct value for money. As a matter of fact, the supervising authorities are particularly alert, and the methods whereby they test the quality of the gas, both during the day and night, are so stringent as to give little opportunity for default on the part of the gas undertakings. The situation is such, in fact, that in order to avoid risk, the undertakings have been working at a substantial margin above their statutory requirements, with the result that the consumer has received something in the way of a bonus which he probably has not appreciated. The official records of the testing authorities, which relate to the first three months of this year have recently been published, and they indicate that in every cubic foot of gas the South Metropolitan Gas Company supplied 6.4 more B.Th.U. than it need have done, and the Commercial Gas Company made a present to its consumers of 27.5 B.Th.U. per cubic foot. A continuance of such generosity must not, however, be expected, for margins of the kind are likely to involve a serious loss of revenue. For instance, the former concern distributes some 15,000 million cubic feet per annum, while the annual output of the Commercial Gas Company is approximately 4000 million cubic feet. Accordingly, South Londoners have been receiving a present of what in a year would amount to nearly a million therms, a rather larger excess being the good fortune of East London consumers. The full significance of this excess can only be appreciated, however, when it is borne in mind that as a therm now sells for about 11d., the free distribution of a million therms means an annual loss in revenue approaching £50,000.

It has frequently been remarked that the principle of selling gas by therms confers undoubted advantages upon the gas undertakings, and while in some directions that is no doubt the case, the obligation for them to work to a definite "declared calorific value" would seem to be very much to the advantage of the consumer; for, in ensuring immunity from penalties, the gas engineer must necessarily protect himself by giving something away. Carbonisation has not yet reached a stage where it is possible to produce absolutely consistently a gas of some definite heating power. During the past year, gasworks throughout the country have been getting into their stride so far as the provisions of the new Gas Act are concerned. The changes imposed were revolutionary, and necessarily a good deal of caution had to be displayed in the early stages. Familiarity with the new methods has shown, however, that a too cautious attitude has been adopted, and already some of the more important undertakings have given notice of their intention to raise their "declared value." Thus, the Gaslight and Coke Company has notified consumers of an increase of 25 B.Th.U. per cubic foot—*i.e.*, from 475 B.Th.U. to 500 B.Th.U.—while the standard of the product of the South Metropolitan Company is to be raised by 10 B.Th.U. This increase in declared value will, of course, tend to curtail considerably the distribution of free excess heat units; but, even so, the consumer will not stand to lose, for the additional revenue thus obtained will play its part in reducing the therm price.

THE facilities for electrification given under the Trade Facilities Act to the South-Eastern and Chatham have made the users of the Great Eastern suburban services envious. Mr. Neal was asked on May 3rd whether he was aware that districts radiating in a north-easterly and an east-north-easterly direction from the City were provided with more inadequate train facilities than any other suburban locality, and would he consult with the Great Eastern with a view to putting into effect a scheme for the electrification of the Great Eastern suburban lines. Mr. Neal said that the Great Eastern Company had been told that the Trade Facilities Committee would consider an application for assistance, but he understood that the company did not propose to make an application.

Naval Shipbuilding in Japan.

ACCORDING to recent advices from Japan, the conclusion of the Naval Limitation Treaty threatens to cause a serious dislocation of trade and industry in that country. Since the slump in mercantile tonnage set in a great many of the shipbuilding yards which sprang into existence during the war have closed down, while those that remain are finding it more and more difficult to carry on business. When the European War broke out there were only four yards in Japan which could construct ships of more than 1000 tons, but in 1918, when the tonnage boom was at its crest, the number of yards capable of building such vessels had risen to forty-five. To-day only about sixteen survive, and few of them are working on a profitable basis. With the steady falling off in the demand for new merchant vessels, the Japanese shipyards have come to rely largely on naval contracts to keep them employed, so much so that by the end of last year these contracts represented nearly 70 per cent. of the total work on which they were engaged. At this juncture was announced the Government's decision, in conformity with the Washington agreement, to stop all further work on capital ships, and the position of the shipbuilding and kindred industries at once became critical. At the same time the labour element began to grow restive at the prospect of widespread unemployment following the contemplated dismissal of so many workmen from the naval arsenals and private yards. It was estimated that the complete suspension of all the naval construction in progress last November would have involved the discharge of at least 100,000 workpeople from the shipbuilding, engineering, and other trades which are interested in the construction and equipment of warships. So large and sudden an accession to the ranks of the unemployed would have been a serious matter at any time, but it threatened to entail particularly grave consequences in view of the general economic depression from which Japan, in common with all other industrial States, has been suffering for the past three years. The authorities realised, therefore, that unless something was done to ameliorate the situation, naval disarmament, so far from proving beneficial, might land the country in serious domestic difficulties. Nevertheless, they lost no time in fulfilling the obligations which they had assumed in signing the Limitation Treaty. In January last, orders were issued from Tokyo to cease all work on the capital ships then under construction. The vessels immediately concerned were six in number, namely, the battleships Kaga and Tosa, already afloat; the battle-cruisers Amagi and Akagi, which were getting on towards the launching stage, and two similar ships, the Atago and Takao, of which the keels had been laid only a month or two beforehand. In round figures the six vessels thus discontinued had an aggregate displacement of 250,000 tons, and at least 25,000 workpeople were employed either in their actual construction or the manufacture of their machinery, armament, and equipment.

Now, although the Limitation Treaty places definite restrictions on the number of new capital ships and aircraft-carriers that may be built by any one of the signatory Powers, it imposes no such limit on the building of what are described in the document as "auxiliary combatant craft," which include every type of vessel from and below the light cruiser. In these circumstances the Japanese Government decided that the industrial crisis could best be allayed by substituting as many smaller war vessels as possible for the cancelled capital ships. A large number of light cruisers, destroyers, submarines, and fleet auxiliaries had been authorised under the programme of July, 1920, which was to cover a period of eight years, but apparently the last of these vessels was not due to be completed before the year 1928. Whether special legislation will be necessary to anticipate the original dates of laying down is uncertain, but in any case it seems that a considerable number of such vessels have been begun since the beginning of the year. With regard to light cruisers, the position is as follows:—Completed during 1921—Kiso, Ohi, Kitakami, Nagara. Launched during 1921 and now nearly completed—Isudzu and Natori. Begun during 1921—Yura, Kinu, Abukuma, Kaku. Laid down or authorised to be laid down in 1922—Naka, Sendai, Jintsu, Ayase, Otonase, Minase, Yubari. Of the above ships, the Yura was launched on February 15th, and the Kinu is said to be afloat, though her launch has not been officially notified. It is reported on good authority that, with the possible exception of the seven ships commenced or due to be commenced this year, all the light cruisers enumerated are of practically uniform design. The leading particulars of them are as follows:—Length overall, 535ft.; breadth, 47ft.; draught, 16ft.; normal displacement, 5600 to 5900 tons. The machinery consists of geared turbines—Parsons in some ships, Curtis in others—taking steam from twelve boilers of a special Japanese design, resembling the Yarrow type. In the course of her trials the Nagara developed 65,000 shaft horse-power, equivalent to a speed of 33.4 knots, which is a higher speed than has yet been recorded of any other cruising ship in the world. It is possible, however, that the run in question was made when the vessel was in a very light condition, as is customary in Japan when the preliminary trials of a warship are being held. Eight of the twelve boilers in each ship burn oil only, the remaining four being fitted for coal and oil. So far as is known, the only Japanese cruisers with a complete set of oil-burning boilers are the Tatsuta and Tenryu, completed in 1919, which are very like enlarged destroyers, and made 33 knots on trial with 51,000 shaft horse-power. The later ships have side armour of about 2in. thickness amidships, and are well subdivided—a form of protection which has been very skilfully developed by Japanese designers since the war. As main armament seven 5.5in. 50-calibre quick-firing guns are carried, all disposed on the centre line and at the same level. In addition, there are two 3in. anti-aircraft guns and eight above-water torpedo tubes, twin-mounted. The fuel supply is said to be larger than is usual in vessels of this type, and with maximum storage the cruising endurance at economical speed is 6000 nautical miles. It is known that a much improved design, with considerably larger displacement and heavier armament, has been prepared by the Director of Naval Construction, Vice-Admiral Okada, and in all probability several of the ships laid down in the current year will be of this improved type. In numerical strength the Japanese cruiser fleet is second only to the British, and far surpasses the American. For light cruisers built, building, or authorised, less than ten years old from date of completion and with speeds above 25 knots, the present figures for the three navies are as follows:—British Empire, 54; Japan, 26; United States, 10.

The Japanese destroyers under construction early this year numbered at least twenty, of which more than half are large and powerful boats, resembling in dimensions and armament the British destroyers of the "Admiralty W" class. Orders for a further twelve destroyers are reported to have been placed, but in the case of these later boats the building period will be intentionally prolonged. No dependable information is available respecting the submarine programme, but at least six yards, including the State arsenals at Yokosuka, Kure, and Sasebo, have submarines on the stocks. In February last the Kawasaki yard at Kobe announced that it had on its books the contracts for twelve submarines, of which, presumably, some had still to be laid down.

While it is clear from the foregoing brief survey that a considerable amount of new naval construction is still proceeding in Japan, the work in hand does not in any way infringe the provisions of the Washington Treaty. The Japanese Government is no doubt as sincerely desirous as any other of avoiding a repetition of the building-slip rivalry which has always been a fruitful cause of international conflict. At the same time it has not seen its way to adopt that policy of complete naval disarmament which would have brought ruin upon an important branch of domestic industry.

Literature.

SHORT NOTICES.

The Analysis of Coal and its By-products. By S. Ray Illingworth. London: The *Colliery Guardian* Company, Limited. 21s. net.—This is one of the most comprehensive works on the analysis of coal which we have met with, and although it is written by a chemist the reading matter is of such a nature as to be readily followed by a practical engineer. The author, in his preface, suggests that the reason why coal is not commonly bought and sold on specification is to be found in the lack of agreement between buyer and seller, as to the proper method of analysis. He thus, throughout the book, gives the relative merits of alternative methods of testing. Considerable prominence is given to the important process of taking samples, and all the various chemical and physical tests which are necessary to get a complete knowledge of the character of coal are described. The scheme is extended to include the principal by-products of gas-making and the analysis of gas. Throughout the volume, excellent suggestions are made for the most economical use of coal, both as a combustible and as a raw material.

Modern Tunnelling. By D. W. Brunton and J. A. Davis. New York: John Wiley and Sons. 1922. 33s. net.—This is the second edition of the work, and has been extended by new chapters on railway tunnelling by Mr. J. V. Davies. The book has, however, been considerably enlarged in other directions, as the original edition was confined to mine and water supply tunnels, while it now covers practically every class of tunnelling. The greater part of the reading matter naturally deals with American practice, but not to the exclusion of European examples. Interesting accounts are given of the expedients adopted in some cases to meet unusual conditions, such as the ignition, by distantly controlled electric arcs, of the explosive gases met in driving one tunnel. Some of the more celebrated accidents and their causes are described, while the precautions necessary for safety are given. There is a long chapter of bibliography and another of costs of tunnel work in America.

Mechanical Appliances for Handling Railway Traffic. By G. Bulkeley. London: The *Railway Gazette*. 5s. net.—An excellent little book describing all sorts of labour-saving devices for handling miscellaneous goods at railway depôts and docks. The author makes out a strong case for the general use of such appliances in the place of manual labour, and illustrates them in great variety. He mentions, as an instance of primitive methods, the landing of some boilers in China, where everything is lifted directly by coolies, but does not refer to the remarkably expeditious way in which vessels are loaded with packed goods when each package is carried by a coolie right from the go-down to the steamer's hold, or *vice versâ*. Manual labour is, of course, very flexible and adaptable, but its price is so high in Europe that it must be replaced, as far as possible, by apparatus such as the author describes and illustrates.

Plumber's Handbook. By S. E. Dibble. New York: McGraw-Hill Book Company. 1922. 20s. net.—This is an extensive book, of over 600 pages, and gives a large amount of information on the American style of plumbing, including heating and ventilating; but its bulk might have been reduced materially by the omission of some sections without affecting its usefulness. Thus nearly one hundred pages are devoted to metallurgy and chemistry, while there is a section on mathematics giving information which could be found in any pocket-book. The handbook should be, nevertheless, quite useful, as it brings together, within one cover, a large fund of information concerning a wide subject. The illustrations are well reproduced, but unfortunately are not always given their proper figure numbers or legends.

Pocket-book of Marine Engineering. By A. E. Seaton. London: Charles Griffin and Co. 1922.—Better known as "Seaton and Rounthwaite's," this is the fifteenth edition of the pocket-book, which has been in existence for almost thirty years, and requires no introduction to marine engineers. The present edition has needed more drastic treatment than has been required at other revisions, as the old rules of the Board of Trade, Lloyd's Register, the British Corporation and the Bureau Veritas have been superseded by the new unified rules based on the recommendations of the British Marine Engineering Design and Construction Committee. This change has, of course, necessitated the recasting of a number of the tables and schedules. The book now comprises over 760 closely printed pages.

Power's Practical Refrigeration. New York: The McGraw-Hill Book Company. 1921. 10s. net.—This book is largely comprised of articles which have appeared in *Power*, and deals fairly comprehensively with the practical side of refrigeration. There are a number of stories, written in typical American slang, which nevertheless give some very practical hints on the running and repairing of refrigerating plant.

Practical Engraving on Metal. London: Percival Marshall and Co. 1s. 6d. net.—This little book is obviously intended rather for the amateur than for the professional engraver, but it gives some very practical hints. In it there are described all the tools and appliances required, together with their manipulation. Lettering and copper plate engraving are dealt with, besides the more ornamental styles of work, such as monograms and carved work.

BOOKS RECEIVED.

Transactions and Year Book of the University of Toronto Engineering Society. Toronto: Published by the Society.

The Industrial Application of the Ball Hardness Test, with Brinell Hardness Number Tables. Coventry: Alfred Herbert, Limited. Price 3s. 6d. post free.

Science in the Service of Man: Electricity. By S. G. Starling. London: Longmans, Green and Co., 39, Paternoster-row, E.C. 4. Price 10s. 6d. net.

Kempe's Engineer's Year Book, 1922. By H. R. Kempe and W. Hanneford Smith. London: Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. 4. Price 30s. net.

Essentials in the Theory of Framed Structures. By C. A. Ellis. London: McGraw-Hill Publishing Company, Limited, 6 and 8, Bouverie-street, E.C. 4. Price 17s. 6d. net.

The Empire Municipal Directory and Year Book, 1922–23. London: *Municipal Engineering and The Sanitary Record*, 8, Breams-buildings, Chancery-lane, E.C. 4. Price 11s. net.

Manuel des Chemins de Fer: Etude et Construction. By J. Bourde, Ingénieur des Travaux publics de l'Etat. Paris: La Librairie J.-B. Baillière et Fils, 19, Rue Hautefeuille. Price 12f.

A Dictionary of Applied Chemistry. By Sir Edward Thorpe, F.R.S. Vol. III. Revised and enlarged edition. London: Longmans, Green and Co., 39, Paternoster-row, E.C. 4. Price £3 net.

Canada as a Market for British Goods. With introductions by Sir Peter Rylands and Stanley Machin. London, Selwyn and Blount, Limited, 21, York-buildings, Adelphi, W.C. 2. Price 7s. 6d. net.

Smithsonian Institution, United States National Museum, Report on the Progress and Condition of the United States National Museum for the year ending June 30th, 1921. Washington, D.C.: Government Printing Office.

Annual Reports of the Society of Chemical Industry on the Progress of Applied Chemistry. 1921. Vol. VI. London: Society of Chemical Industry, Central House, 46–47, Finsbury-square, E.C. 2. Prices, to members 7s. 6d.; non-members 12s. 6d.

The Petroleum Industry. A Brief Survey of the Technology of Petroleum based upon a Course of Lectures given by Members of the Institution of Petroleum Technologists on the occasion of the Petroleum Exhibition, Crystal Palace, 1920. Contributors: Sir F. W. Black, K.C.B., B.A., E. H. Cunningham Craig, B.A., G. Howell, Hubert May, H. Barringer, F. B. Thole, D.Sc., W. R. Ormandy, D.Sc., Professor J. S. S. Brame, Jas. Kewley, M.A., Arthur W. Eastlake. Editor: A. E. Dunstan. London: The Institution of Petroleum Technologists, 5, John-street, Adelphi, London, W.C. 2. Price 14s. 6d. net; to members 10s. 6d. net.

The Manufacture of Diesel Engines.

ALL types of internal combustion engine demand very good workmanship and materials if good condition is to be maintained for a number of years; hence their cost is very high unless the best modern methods of production are adopted. It is well known that such methods fulfil the double service of increasing accuracy and reducing manufacturing costs, and without their employment it is practically impossible to produce really reliable engines on a commercial basis. For that reason they have been adopted by Mirrlees, Bickerton and Day, Limited, who have courteously given us facilities for describing the interesting tools, jigs and rigs employed by them. An essential element in the employment of devices of the kind is the adoption of standards, and that can only be done in the case of the Diesel engine by fixing upon a certain range of cylinder sizes and combining the cylinders in such numbers as will give the required total horse-power. For instance, we may take units of 50 horse-power and combine them up to six in number to produce a total of 300 horse-power, or we may take units of 125 horse-power and combine them in threes, fours and sixes to obtain total powers of 375, 500 and 750 respectively.

The limitation of the number of different parts which is thus secured not only renders possible methods of manufacture which would not otherwise be practicable, but enables the makers to manufacture to stock with a minimum amount of capital expenditure. Furthermore, it affords opportunities for securing a very large experience of the working of each detail of construction.

The system of stock manufacture adopted by Mirrlees, Bickerton and Day is to make large numbers of those parts which are common to many engines and a smaller number of the parts which are special to one size of engine. Thus cylinders, cylinder covers, columns, pistons, valves, valve levers and connecting-rods are made in batches of considerable numbers, whilst bed-plates and crank shafts are made in fewer numbers. If an order is received for, say, a six-cylinder 300 brake horse-power engine, the bed-plate and crank shaft and similar special parts are drawn from the relatively small stock, whilst the cylinders, pistons, &c., are drawn from the large stock of such parts. This aspect is very important from a commercial, as well as a manufacturing, point of view, as it will be readily appreciated that when dealing with engines of 50 and 125 horse-power per cylinder, the capital sunk in stocking a number of complete engines of each size would be very heavy indeed, and would thus seriously add to the cost of production. The large numbers of duplicate parts resulting from this system enables automatic machinery to be employed in connection with the smaller parts, whilst with all parts it justifies the expenditure necessary for a very complete system of jigs and gauges.

In considering the following description of some interesting jigs and methods of manufacture, it must be kept in mind that the objects aimed at are twofold:—

(1) *Real Interchangeability of Parts.*—This is a very important feature in manufacturing under the system described, as the parts are not made for any special engine. Thus, if a three-cylinder engine is to be assembled, three cylinders are drawn from the stock, three pistons, three covers, three columns, three air valves, three exhaust valves, &c., and these parts must assemble together with the necessary accuracy. At first sight, this point would appear to be one which is only of interest to manufacturers, but it is equally important to users, for it ensures the interchangeability of spare parts stored by the user or obtained from the makers' agents in any part of the world.

(2) *Cost Reduction.*—The jigs must give interchangeability, and reduce the time necessary to produce the parts; they must also effect a direct reduction of cost, and by giving increased production from the plant, cause indirect cost reduction. These points have been kept in mind in devising the jigs and appliances which we now proceed to describe.

FIG. 1—CONNECTING RODS IN BORING MACHINE

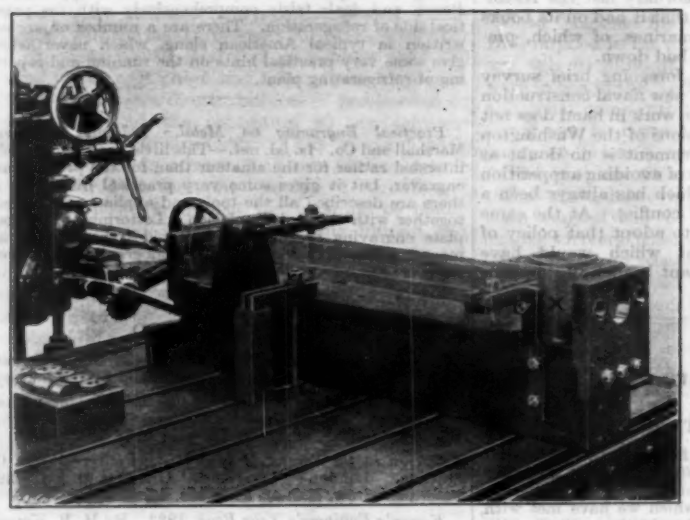


FIG. 2—DRILLING BOLT HOLES IN CONNECTING ROD

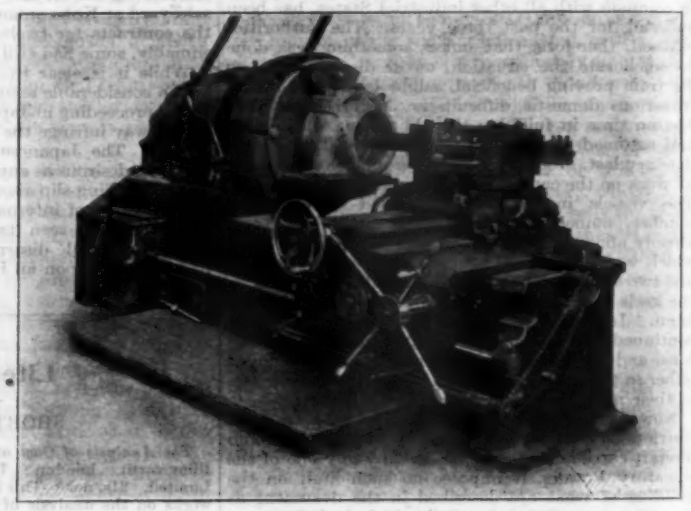


FIG. 3—BORING BIG END FOR WHITE METAL

We take as our first example a connecting-rod, which is received for the first machining operation as a drop forging. After being centred it is turned to diameters and length in a centre lathe, spigots at either end being machined to a size limit of minus .001in. in diameter; these spigots form the main locating points for all further operations on the rod. The top end is then roughly trepanned out, leaving about $^{5}/_{16}$in. diameter for finished boring, which is carried out, in pairs, in a fixture—Fig. 1—on a powerful horizontal boring machine. The rods are located by the spigots in hardened bushes in the bottom plate of the jig and at the palm end by sliding bushes, which drop over the other spigot, thus ensuring that the top end bore is square to the centre line of the rod. The boring bar has a flexible drive and is carried in hardened bushes in the jig.

The rods are then inspected by placing a ground mandrel in the bore and measuring for parallelism with the foot. This test is identical in method with that illustrated later by Fig. 6, except that the mandrel is of larger diameter than is there shown, as it fits into the bored hole in the rod itself instead of that in the brasses.

After the sides of the top and bottom ends have been machined to width and the brass bush pressed into the top end, the next operation is the drilling of the bolt holes in the top and bottom ends, as illustrated in Fig. 2. In this illustration the connecting-rod has been "ghosted," so that the jig can be more plainly seen. The spigot at the palm end of the rod lies in a half-round hardened bush, whilst the other spigot rests on a hardened flat strip, in order to allow the top end bearing of the rod to be clamped against the hardened pin marked X, thus ensuring that the bolt holes in the palm end shall be bored so that the centre line through them is strictly square with the bore of the top end of the rod. The top end is then sawn through, the halves of the bush separated and the bolts fitted. Inspection for parallelism, as shown in Fig. 6, is then made.

The bottom or big end is formed by a pair of steps lined with white metal. The first operations on them are facing them where they come together and on the ends and recessing one of them to receive the spigot on the rod. They are then drilled for bolt holes in a heavy double-spindle drill, which, with the drilling jig, is illustrated by Fig. 4. A feature of this jig is a rising spigot which enters the recess just referred to, and so centres the casting, which is

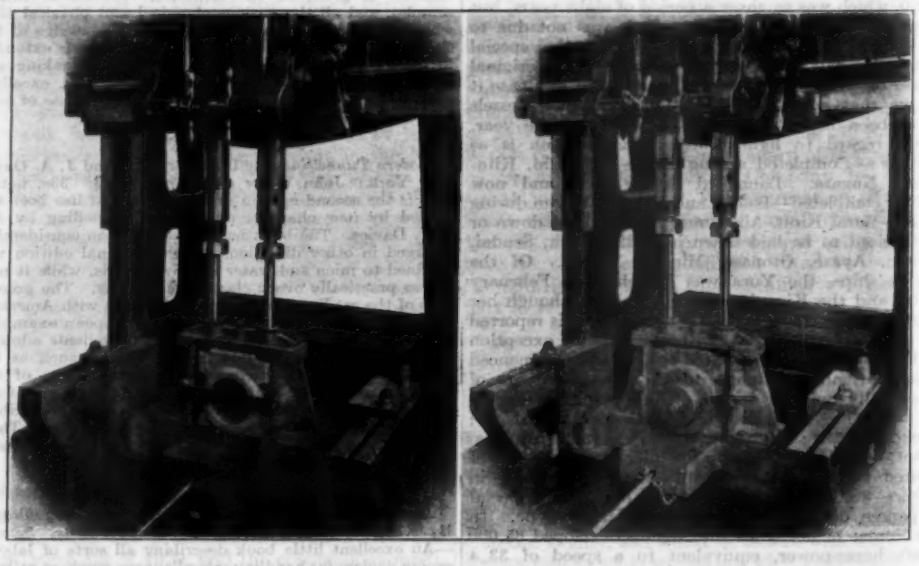
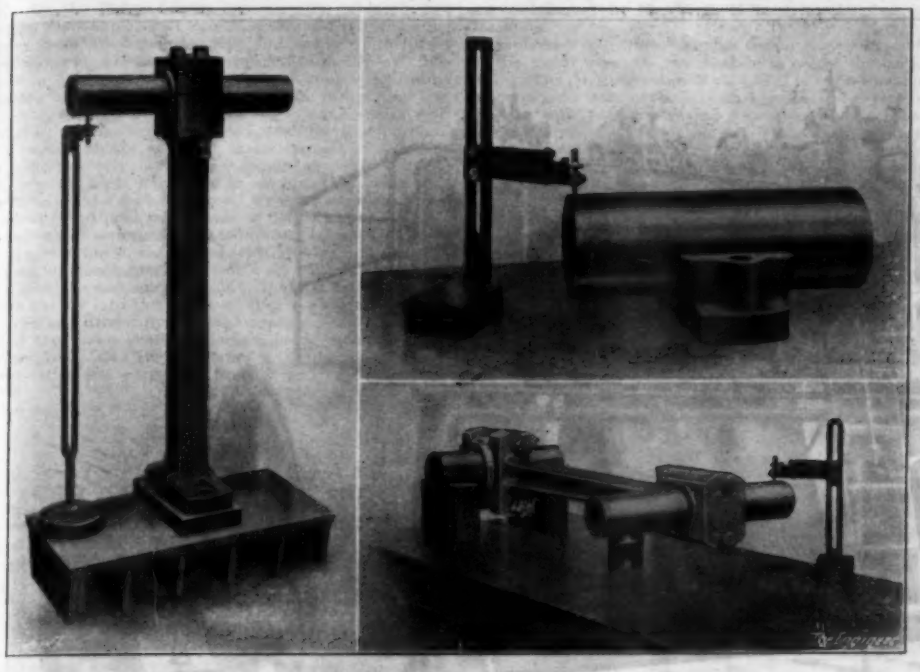


FIG. 4—DRILLING BOLT HOLES IN BIG END

FIG. 5—FINISH-BORING BOLT HOLES IN BIG END

then set in the other direction by folding wedges. The holes are bored $^1/_{16}$in. less than the finished size. The boring bars are carried in bushes in the top and bottom plates, and the drive is flexible.



FIGS. 6, 7, AND 8—METHODS OF TESTING FOR PARALLELISM

The next process on these bottom ends is boring to receive the white metal. This is carried out in a lathe by means of a fixture similar to that shown in Fig. 3, which ensures the bore being in correct relationship with the bolt holes and with the face which bolts up to the connection rod. The two halves are then passed forward for white-metalling. Quite unusual care is taken with this operation; not only are all the surfaces and recesses which are to receive the white metal machined, but they are also most carefully cleaned and polished immediately before being tinned. When moulding the white metal, special care is taken to regulate the temperature, as micrograph records have shown that the pouring heat has a great influence on the structure of the metal. The machining of the bore to finished size is done in the jig illustrated by Fig. 3.

The firm's experience has shown that the process of white-metalling sometimes causes a little distortion. To eliminate any chance of inaccuracy from this cause, the face which bolts to the connecting-rod is next ground quite flat and parallel with the bore, as illustrated by Fig. 9, the parallelism with the bore being secured by the fact that the bored portion rests on the semi-circular pin attached to the grinding machine table. The error limit allowed in this process is one-quarter of one-thousandth of an inch. The method of inspection is illustrated by Fig. 7.

The next operation is to finish bore the bolt holes square with the main bore, and thus remove any effects of distortion at the bolt holes. The jig for this process is illustrated by Fig. 5. It is of unusual construction, but is similar to that used for the rough boring operation, with the addition of a large mandrel and sliding bush mounted on an angle plate at the back of the jig; this mandrel, being free to move vertically, is lowered into the bored half of the bush, and thus sets the bore exactly square with the bolt holes. The lateral position of the piece is then located by means of the screwed collar shown on the illustration, the top half having been previously put into position. The bolt holes are then bored to final size.

In the manner described, relationship of the bolt holes to the bore and to the face which bolts up to the rod is very accurately determined, and any error due to distortion in consequence of the heating which occurs during white-metalling is eliminated. In this way complete interchangeability of these portions is assured. After the rod has been completely assembled, the alignment of the top and bottom bores is tested for parallelism in the manner shown in Fig. 8.

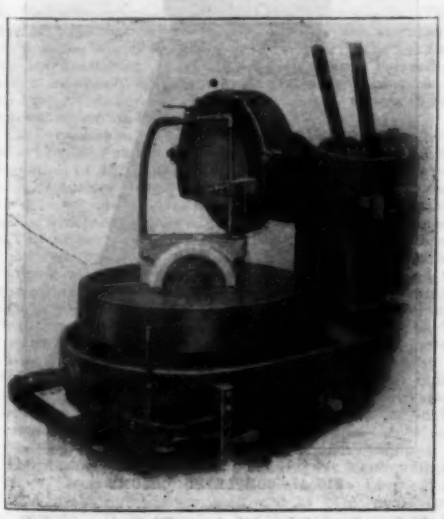


FIG. 9—GRINDING FACE OF BIG-END CAP

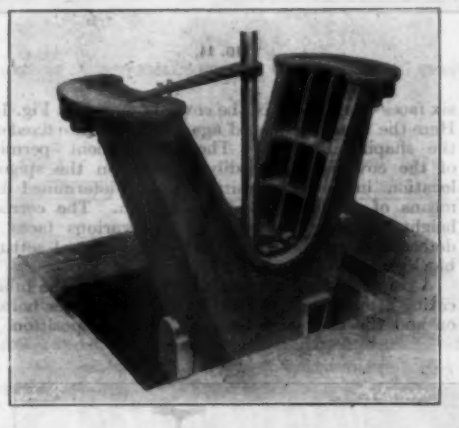


FIG. 10—TESTING FOR SQUARENESS OF FEET

FIG. 11—DRILLING CYLINDER COVER STUD HOLES

As our next example we take a main column of the 50 brake horse-power per cylinder type. The general appearance of the column will be seen from several of the illustrations. The power cylinder is formed by a liner of special cast iron which is put into the column, and in connection with this liner a very interesting problem of production arises. The internal surface of the liner is lubricated at six different points, and for this purpose the fittings are carried through the column and water space into the liner. For some years the holes in the liner were specially drilled after the liner had been put into position, as it was generally considered impracticable to drill the liners and columns separately with sufficient accuracy to ensure that the radial fittings would fit satisfactorily. However, the Mirrlees Company faced this problem by means of very expensive jigs, and it has succeeded in carrying through the process in such a way that all liners and columns are separately drilled, and any liner drawn from stock will fit properly in any column, thus allowing the lubricating fittings to be satisfactorily attached.

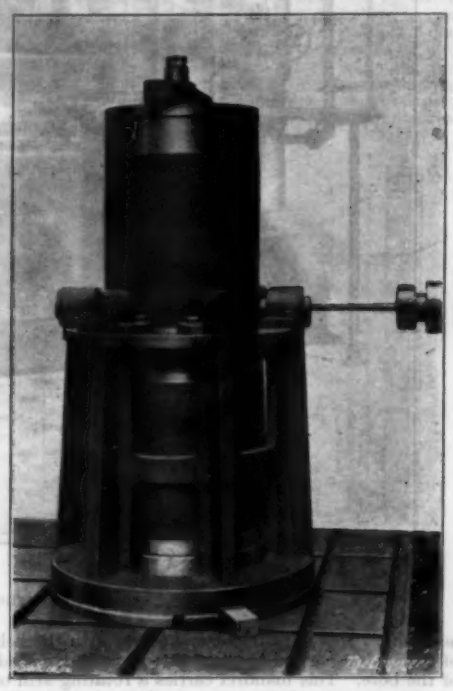


FIG. 13—JIG USED WHEN DRILLING HOLES IN LINER

The heaviest operations on the column are the boring for the liner and the facing of the feet. These operations are carried out at one time and at one setting in a very large boring machine made to the firm's design. The fact that the foot of the column is faced at the same time as the bore is machined ensures that, as far as is practicable, the machined feet will be exactly at right angles to the bore. Notwithstanding this feature of the machining process, the additional precaution shown by Fig. 10 is taken, and any slight adjustment necessary is made to secure absolute

FIG. 12—JIG FOR MILLING AND DRILLING COLUMNS

300-B.H.P. SIX-CYLINDER DIESEL ENGINE

MIRRLEES, BICKERTON AND DAY, LIMITED, HAZEL GROVE, STOCKPORT, ENGINEERS

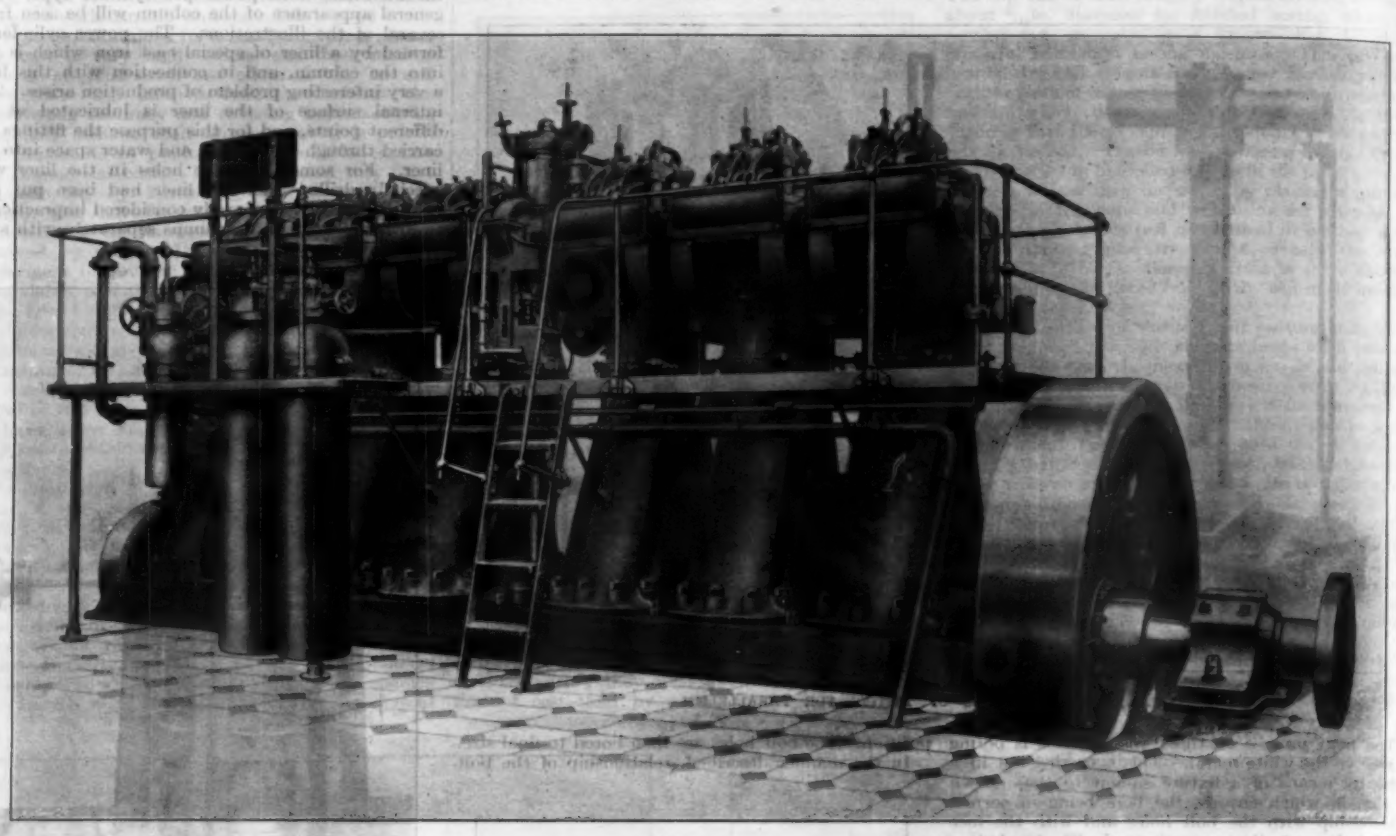


FIG. 14

accuracy. This adjustment is effected with the help of a mandrel carried in discs fitted in the two ends of the bore. This mandrel carries a rotating arm on which are mounted micrometer points, thus enabling a very accurate test to be made of the squareness of the feet with the bore.

The jig used when drilling the holes in the top of the column for the cylinder cover studs and for the camshaft bearings is shown in Fig. 11.

In the next operation—Fig. 12—the column inverted is placed in the jig shown, which rests on a circular plate so arranged that the column can be rotated quite easily and be correctly located in the different positions. The jig is first used for the milling of all the various faces on the column sides, and then for the exact drilling of the aforementioned holes for the lubricator fittings. Fig. 13 shows the jig for drilling the corresponding holes in a liner. By means of these jigs, the usually difficult drilling operation already referred to is converted into a very simple and very exact one.

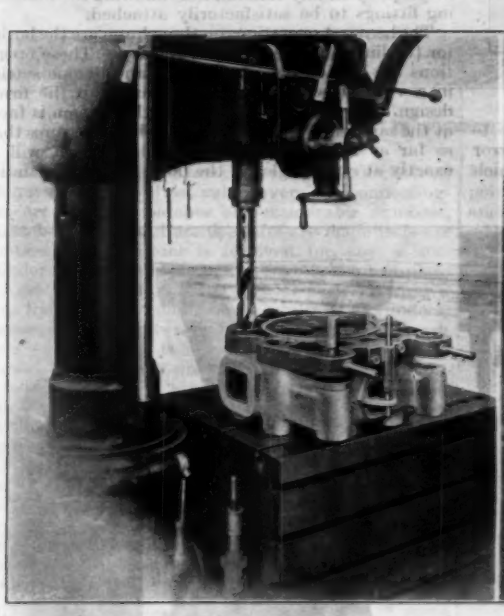


FIG. 15—DRILLING CYLINDER COVER

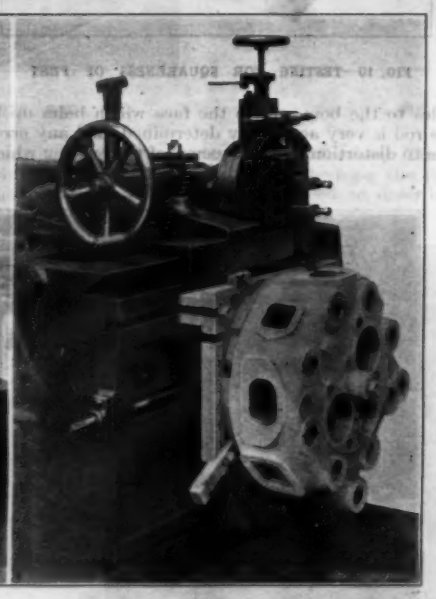


FIG. 16—MACHINING CYLINDER COVER

In machining a cylinder cover, the part is first turned on both faces, and spigots formed thereon. These spigots are then used for locating the drilling jig shown in Fig. 15. The method of machining the six faces on the sides of the cover is shown by Fig. 16. Here the face is mounted against a jig plate fixed on the shaping machine. The arrangement permits of the cover being readily rotated on the spigot, location in correct position being determined by means of a plunger and steady pin. The correct height for the machining of the various faces is determined by means of the hardened steel setting blocks marked X on Fig. 16.

A completed column with liner fitted in, the lubricating attachments to the liner fitted, a cover bolted on and the various valves and levers in position, is shown by Fig. 17, whilst Fig. 14 gives a general illustration of a six-cylinder 300 brake horse-power engine. As already mentioned, most of the parts of an engine are identical whether the engine has one, two, or even six cylinders. The engine illustrated has six cylinders of the 50 horse-power per cylinder type, and is therefore suitable for 300 brake horse-power.

We have described the methods of manufacture of a connecting-rod, column, and a cylinder cover. They are typical of the methods adopted through the engine. Concentration on the manufacture of a few sizes has, as so often occurs, resulted in exceptionally efficient methods of production, both from the point of view of cost and of quality. At a later date, we hope to describe some of the other very interesting methods adopted by Mirrlees, Bickerton and Day, Limited, at their Hazel Grove works.

FIG. 17—COMPLETED COLUMN

THE locomotives built at Woolwich to provide against unemployment, mentioned on page 304 of our issue of March 17th, are estimated to have cost about £16,000 each

Electrically-Driven High Pressure Centrifugal Pump.

THE waterworks engineer to the Manchester Corporation, Mr. L. Holme-Lewis, has recently replaced two vertical triple-expansion condensing steam-driven pumping sets in the Whitworth-street pumping station by the plant of which we give illustrations on page 584 and below. The plant in this station is provided to supply hydraulic pressure at 1120 lb. per square inch for public use. Hitherto, only reciprocating pumps, in conjunction with hydraulic intensifiers have been used for this purpose. These steam pumps, of which there were six of 210 indicated horse-power each and capable of delivering 240 gallons per minute, have been in use for many years, and it was decided to replace two of them by one electrically operated centrifugal set capable of delivering 800 gallons per minute at a pressure of 1150 lb. per square inch, and the contract for it was placed with Holden and Brooke, Limited, of Manchester.

To give the necessary pressure, the makers decided to divide the set into two units, each of six stages, coupled in series and driven by flexible couplings, one from each end of the motor shaft, the whole being mounted on a common bed-plate. The pumps are of the makers' standard design, with the exception that in this case they are provided with external bearings at the delivery ends. This form of construction was necessitated by the engineer's specification, which called for the fitting of Michell thrust bearings, in addition to the automatic hydraulic balancing, though in operation these thrust bearings do not carry any load. This arrangement is very clearly shown in the sectional elevation of the pump.

The impellers are made of a special bronze alloy, which has a breaking stress of 35 tons per square inch and an elongation of 15 to 20 per cent. The guide passages are made of similar metal, and each set of passages is cast in one complete ring entirely separate from the pump bodies, which are of steel. These guide passage rings are held in place by a number of long bolts which extend from cover to cover. To facilitate renewals, the bodies are fitted with loose rings in all parts that are subject to wear owing to the running of the impellers. These rings are also made of a special bronze. The end covers of the low-pressure pump are of cast iron, but those of the high-pressure pump are of cast steel. All the pump and motor bearings are lubricated by oil, which is supplied by a small centrifugal pump operated by means of an independent electric motor. An oil cooler is also provided. The water, after passing from the delivering of the high-pressure pump, is led through a Venturi meter, which measures the rate of flow and also the quantity pumped.

The motor, which was supplied by the Metropolitan-Vickers Electrical Manufacturing Company, Limited, is of 1000 brake horse-power, and runs at 1475 revolutions per minute. It is operated by three-phase current at 6500 volts and 50 cycles, and is fitted with fans which draw the cooling air through a Sturtevant filter plant, capable of dealing with 7000 cubic feet of air per minute.

Cold-Headed Bolts.

THE following notes on the capacity of steel to withstand upsetting in the process of making cold-headed bolts are contributed by Mr. V. E. Hillman to the *American Machinist*.

The term "cold work" implies that energy is expended on the metal when its temperature is below the critical range. The microstructure of the metal prior to the application of cold work consists of an aggregate of crystalline grains or cells, each grain being a structural unit. It may suffer rupture or deformation; it may be enlarged, elongated, stressed, or restored to its normal size and shape. When the metal is subjected to mechanical pressure, the crystals are crushed and intimately mixed. Cold water has an embrittling effect upon the metal and the grains which were originally equiaxed or elongated, assume a ropy appearance resembling fibre. In brief, the grains loss their original identity.

There is a limit to the amount of cold work which a piece of steel will sustain. Therefore, the cold working of the metal must be interrupted from time to time to relieve the internal stresses which have been developed. In other words, if the strained steel be heated to above its critical range, for 15 minutes at 1650 deg. Fah., and quenched, the elongated grain fibres will be effaced and renewed toughness will be conferred on the metal. A lower annealing temperature, 1150 deg. Fah., for one hour will also suffice to remove, partially at least, the embrittling effect of cold work. It should be borne in mind, however, that only the strained ferrite grains are influenced by the lower annealing temperature.

Soft basic steel is well adapted for the cold heading process. The carbon content in the metal, however, should be regulated carefully. It is a well-recognised fact that if an attempt be made to upset a piece of high carbon stock, the steel will simply bend over, whereas material of the proper analysis, 0.10 to 0.20 per cent. carbon, will flow readily into a compact mass.

There is a limit to the volume of metal that can be fabricated into the head of a bolt. The maximum length of stock that can be formed into the head is equivalent to seven times the diameter of the rod which is being upset. That is to say, if the diameter of the rod be ½in. then it is possible to crush 1¾ linear inches into the head. These tolerances should be followed if "cold shuts" are to be the exception and not the rule.

The reliability of a cold-headed bolt is dependent upon the number of blows it received during the fabrication process. The limit of stock which can be compressed into the head by a single blow is two and one-half times the diameter of the rod. Cold-headed bolts of commerce are generally subjected to two or three blows. However, there are instances where four, five and six blows are required to effect a reliable upset.

Conclusions: Various degrees of distortion may be found in the same bolt. Certain regions undergo slight deformation, whereas other sections undergo extreme distortion.

Annealing at 1150 deg. Fah. will remove the weakening effects of cold work. Irrespective of the degree of cold work, crystallisation will not take place below 1280 deg. or above 1380 deg. Fah. If the temperature of the furnace reaches the hazardous zone, 1280 deg. to 1380 deg. Fah., crystallisation will take place only in those areas which have been slightly strained.

Annealing above the critical range 1650 deg. Fah. is preferable.

In this range of temperature, 1625 deg. to 1675 deg. Fah., and regardless of the degree of strain, crystallisation will not result.

The successful manufacture of cold-headed bolts demands the application of fundamental metallurgical principles. The quality and service of the finished product is therefore dependent upon an adherence to the laws of metallurgy.

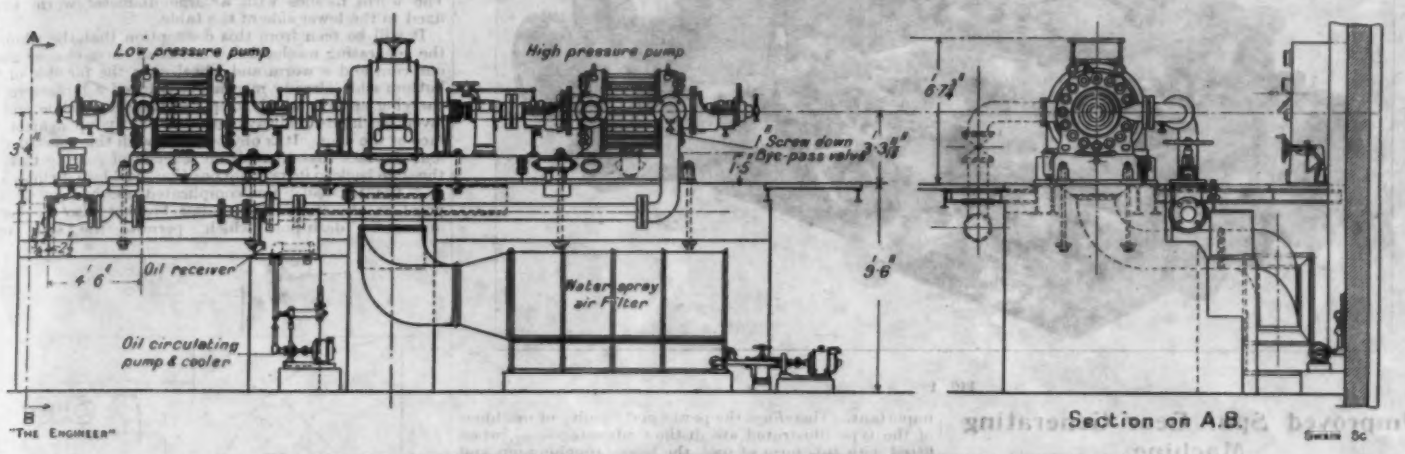
ZINC DUST FOR SHERARDISING.

THE iron content in a zinc dust used in a sherardising process should be low, according to an article by Mr. L. McCulloch in the *American Machinist*, but there is some question as to what the limits should be. "Dross" dust containing iron is cheap and the percentage of iron increases with use, as zinc is removed while the iron remains. Iron in dust is useful, as it raises the melting point and prevents fusing or caking when a high temperature is used to give rapid deposition. Iron, however, rapidly lowers the rate of deposition, making it necessary to employ higher temperatures, indicating that the iron content should not exceed 7 per cent.

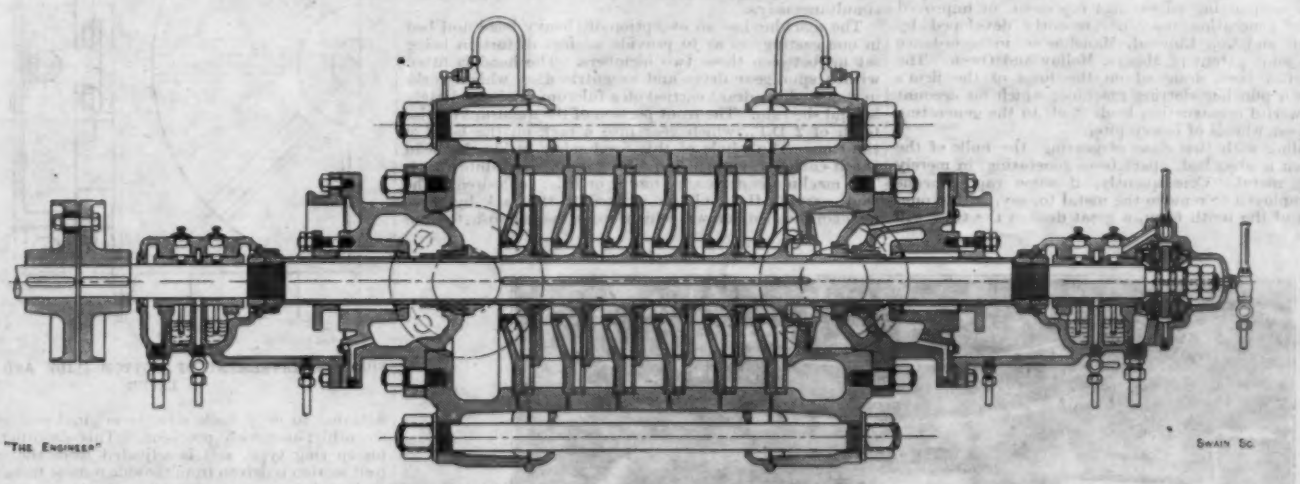
Life tests show that there is a minimum weight of zinc per square inch necessary for good coatings; to test the value of sherardising, the weight of zinc should therefore be determined. A new method depends on the fact that a boiling 10 per cent. solution of ammonium chloride removes zinc from sherardised coatings rapidly, but does not dissolve iron until the zinc is practically gone. This test may be applied in two ways:—The coating is completely removed and its amount determined by loss in weight; or the weight of the coating is found approximately by noting the time for iron to appear in the boiling solution. At each five-minute interval a drop of the solution is removed upon a spot-plate and tested with potassium ferricyanide for the presence of iron. When the blue colour appears, the coating is gone, and the time is a measure of the weight of zinc. A good coating should withstand this test for ten or fifteen minutes.

A comparison of short-time rusting tests, such as the salt spray, with tests in actual service, shows that rusting in the short-time tests does not necessarily mean a short life in service. The rapid rusting tests are, however, of value in judging the quality of a coating, when an actual determination of the weight of zinc is made at the same time. These two methods of testing should supplement each other.

A DIPPER for dredgers which tips its load out over the front, instead of dropping it through a door in the bottom, has been produced by a Michigan company. The dipper is said to be very convenient in handling large boulders or roots.



SIDE AND END ELEVATIONS OF ELECTRICALLY-DRIVEN HIGH PRESSURE CENTRIFUGAL PUMPING SET



LONGITUDINAL SECTION OF SIX-STAGE CENTRIFUGAL PUMP

SPUR GEAR GENERATING MACHINE

WILLIAM MUIR AND CO., LIMITED, MANCHESTER, ENGINEERS

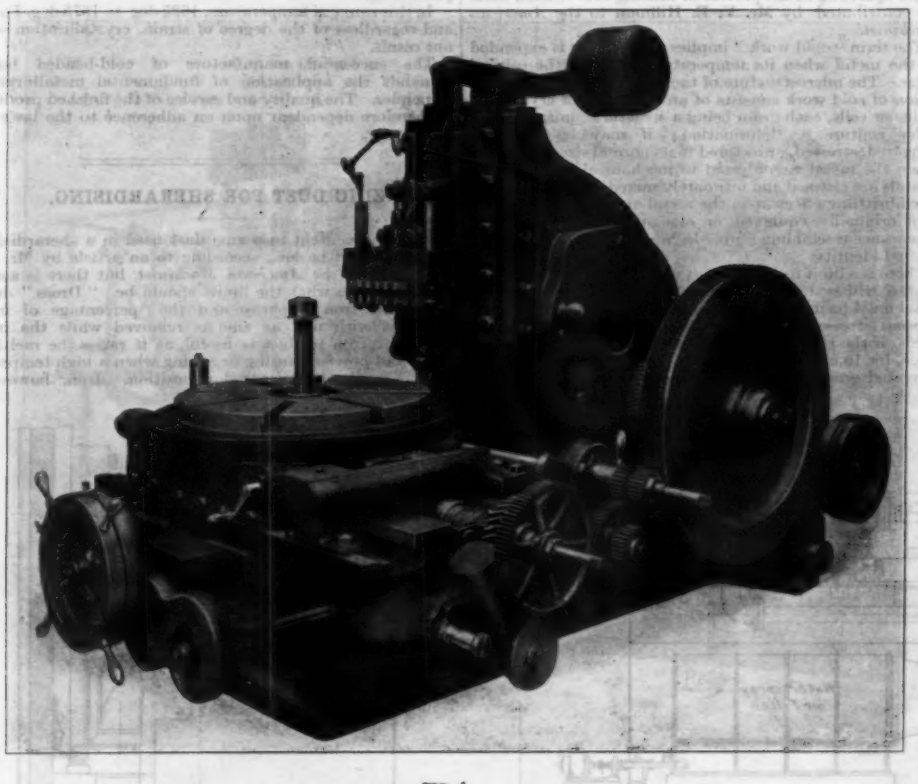


FIG. 1

Improved Spur Gear Generating Machine.

THE accompanying engravings represent an improved spur gear generating machine, recently developed by Wm. Muir and Co., Limited, Manchester, in accordance with the joint patent of Messrs. Melloy and Owen. The machine has been designed on the lines of the firm's well-known puncher slotting machine, which on account of its powerful construction lends itself to the generating of steel gear wheels of heavy pitch.

In dealing with this class of gearing, the bulk of the time taken is absorbed, apart from generating, in merely removing metal. Consequently, if some rapid means can be employed to remove the metal to, say, within one-sixteenth of the tooth form, a great deal of the time will be saved. The puncher slotting machine was developed primarily for the rapid removal of metal, and therefore this gashing out of large pitch steel gears is an operation for which the machine is eminently suitable. This operation, being performed in the minimum of time, the final generating is rendered both easy and rapid. The preliminary gashing out, however, as an operation preceding the generating process, is not adopted for the smaller pitches, double tools being employed instead, as in the machine under notice.

In attempting to take heavy cuts in steel with an ordinary rack tool, the front and side cuttings, in coming away under the tool, tend to foul one another and "choke" the tool. As a consequence, the feed has to be reduced until this action does not take place, and time is thus lost. In the "Melloy" patented tool two cutters are employed, the lower or front tool cutting on the front only, and the upper V-shaped rack tool cutting only on the sides. In this way, three distinct and separate cuts are produced, the metal from each coming away freely. In rack cutter gear generating, it is obvious that the front cut is by far the heavier, and, fortunately, the least important. Therefore, the power and rigidity of machines of the type illustrated are distinct advantages, as, when fitted with this form of tool, the heavy roughing-out and the relatively lighter generating cuts can be performed simultaneously.

The machine has an exceptionally heavy head and bed in one casting, so as to provide against distortion being set up between these two members. The head is fitted with a spur gear drive and excentric disc, which works in a slotted quadrant carried on a fulcrum pin immediately behind the ram. The front portion of the quadrant carries teeth of 2 D.P., which gear into a rack on the back of the ram. The whole of this mechanism inside the head is self-enclosed, and runs in oil, so as to be self-lubricated. The machine is driven by motor or belt, as desired. The ram carrying the tool box is fixed to the rack by three hexagon-headed screws, which are attached to a tee nut fitting on the back of the rack. This construction fulfils two functions; first, it permits the position of the ram or tool box to be adjusted to any desired height with respect to the table, and, secondly, it provides a safety slipping device for the cutter box. The front of the ram is planed on the incline to give the necessary relief on the upstroke, without resorting to the weakness of swivel pins. The ram is balanced, thus enabling the machine to be pulled round easily by means of a hand wheel on the motor shaft or on the cone pulley shaft, to bring the tool into any desired position.

FIG. 2—TRAVERSE MOTION MECHANISM

A long bottom slide rests on the bed, and is under the control of a large diameter screw, which is actuated by gearing at the front in order to provide the self-acting in-feed. A hand wheel is also provided, and is indexed in thousandths to permit the work to be set for the correct depth of tooth. On the end of the slide mentioned is fitted a pair of bevel gear wheels driven from the side-feed shaft. These bevels drive up through a worm and wheel on to a cam shaft. This shaft carries a cam which actuates a swinging lever pivoted to the bottom slide, as shown in Fig. 3. The cam is 2in. pitch and imparts during its revolution always the same angular movement to the lever. Acting on one face of this lever and attached to the side of the transverse slide carrying the table is a small bracket. This bracket is fitted with a vernier, which indicates, along with the scale fitted to the lever, the distance of the bracket pin from the fulcrum of the lever, thus enabling the transverse movement of the slide carrying the table to be accurately set. The bracket is adjustable towards or away from the fulcrum of the lever by means of the small handle shown in Fig. 1. This arrangement controls the transverse movement of the table for cutting different pitches, and does away with the necessity for different cams for different pitches, thus enabling teeth of any pitch from the finest up to 3in. pitch to be produced.

It may be pointed out that although the transverse motion is imparted through a lever, the necessity for correcting for the swing of the lever does not arise, as straight-line motion is imparted to the lever and straight-line motion is taken from it in the same direction. Consequently, the movement of the slide transversely is uniform and in exact proportion to the distance of the pin on the bracket from the fulcrum. The worm already mentioned, which drives up to the cam shaft, can be dropped out of gear to enable the cam shaft to be pulled round by hand.

Connecting up from a 90-tooth wheel on the cam shaft is a set of change wheels, which rotate the worm shaft. In the worm is fitted an adjustment for taking up backlash. The worm meshes with a large diameter worm wheel fixed to the lower side of the table.

It will be seen from this description that the whole of the generating mechanism consists of three change gears, one cam and a worm and wheel. On the far side of the bottom slide already mentioned is fitted a buffer bracket carrying springs which keep the transverse slide and its lever mechanism always pressed tightly up against the face of the cam. It is obvious that with this construction, and the fact that there is no reversal of gearing to bring the slide back to its original position, backlash is eliminated and the necessity for complicated mechanism at this point is obviated. The buffer bracket also carries an automatic dash-pot, which permits the slide upon indexing to drop back into its original position silently, smoothly, and with precision. This dash-pot is of the piston ring type, and is adjusted from the front. The feed motion is driven from the side remote from that shown in Fig. 1 by means of a four-way Geneva stop motion. This gear gives a quarter of a turn to the first feed shaft whilst the cutter is in the "up" position. The motion is transmitted down through change wheels to the cross shaft, and so by mitre gears to the side shaft, which actuates both the in-feed already described and the generating feed in the following manner:—As the motion drives up to the cam shaft, the cam is slightly rotated, thus moving the table transversely across the face of the cutter. At the same time, by means of the change wheels, the worm shaft is also rotated. Thus a combined motion is given to the table, transverse by means of the cam and rotary by means of the worm and wheel. The resultant is a rolling motion along the pitch line of the cutter. This feed takes place at the top of every upstroke until the slide has been moved one or more pitches and the cam bracket has reached the full extent of its movement. Upon the next feed the cam continues its movement in the same direction, and the slide drops back instantly to its original position without any cessation whatever of the vertical reciprocating motion of the tool. In this way, no time is lost during the indexing, no mechanism is necessary to return the slide to its original position, and, backlash being non-existent, causes no trouble. In fact, the makers claim that there is nothing about the machine that the average mechanic is not more or less familiar with. There are no calculations to be made when using it, as the required number of teeth is obtained by placing a change wheel of that number of teeth on the worm shaft and gearing up by means of an idler to the 90-tooth wheel on the cam shaft. A stationary trough is provided round the edge of the table, which conducts the lubricant back into a sump in the bed and provides means for the easy removal of the cuttings into a box at the side of the machine. The machine will cut any reasonable number of teeth—exclusive of primes over 100. Change wheels are provided which give variations of feed from 15 to 72 strokes per drop of the cam. The machine illustrated will deal with gear wheels up to 3ft. diameter by 6in. wide and 3in. in pitch. Much larger machines are at present under construction.

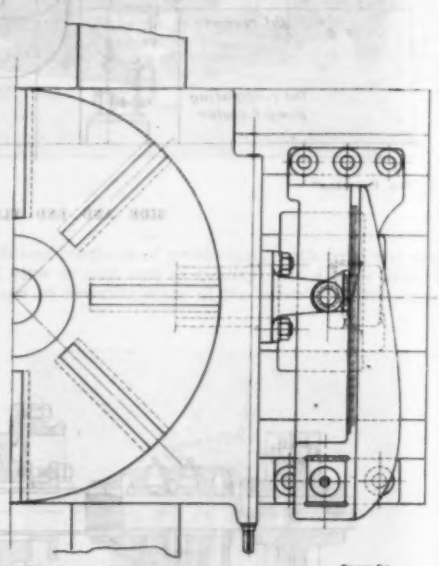


FIG. 3—ARRANGEMENT OF BOTTOM SLIDE AND SWINGING LEVER

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(*From our own Correspondent.*)

The Trade Position.

THOUGH little business is being done, the undertone of the Midland iron and steel market keeps fairly good. The continuation of the dispute in the engineering trade is doing much to contract business, and there is little buying except for immediate requirements. Many plants are only partially engaged, as there is a determination, which is fairly general, not to increase stock. Yet, while business on a big scale is still suspended, the cloud of depression seems to be gradually lifting, and a marked improvement is confidently anticipated when the dispute ends. Unfortunately, the influence of the trouble is more apparent every day. While in the Birmingham district the proportion of unemployed engineers is being steadily reduced, it is reported that in Coventry many engineering works are badly disorganised, and Sheffield, apparently, is in a still worse plight. Both centres are good consumers in normal times of Midland foundry iron. How seriously, too, the industrial dislocation has impaired confidence may be inferred from the indifferent mood of buyers. They have been warned that when a settlement is reached they may look out for a squeeze. Now that a settlement appears to be imminent, buyers are moving quite as cautiously as they were a month ago. The position has been little changed by the re-arrangement of railway freights. Prices are not likely to be affected, for buyers have already obtained equivalent concessions several times over—in price reduction. The high cost of transport has long had a hampering effect on the industries of this district, which have to draw their supplies of coke and furnace material from distant centres, and the relief is so trifling as to be practically inappreciable. People concerned with the heavy trades of Staffordshire say the alterations will do nothing to bring plants that are standing idle into operation. One big local firm of ironmasters estimates the concessions to represent a decrease of 9d. in the cost of producing a ton of pig iron. Another firm, which has had its smelting plant out of commission since the coal strike last year and had everything arranged for making a fresh start as soon as the expected reduction of railway rates took effect, considers it useless even to call the directors together further to consider the question of re-starting.

Small Demand for Pig Iron.

The business done in pig iron this week is smaller than for several weeks past. Whatever the latent requirements may be, consumers are not in the least inclined to anticipate them. If the negotiations for a conclusion of the engineering *impasse* are successful, considerably more pig iron will be wanted than has lately been changing hands, and in some quarters a squeeze is anticipated, but consumers are prepared to take their chance. Prices are practically unchanged. Some furnaces find it necessary to put a proportion of their output into stock. One furnace in Derbyshire which was damped down some time ago has now been extinguished. The fairly strong foreign demand for pig iron continues. Quite a number of American inquiries have come into this district, in Northamptonshire and Derbyshire, ranging from 1000 to 10,000 tons. As a rule, however, they have not led to business, the chief reason being that Midland furnaces competing with Cleveland for American trade have to face a railway transport charge approximating to 12s. per ton before the material can reach the ship side. Consequently, this business has nearly all gone to Cleveland or other furnaces on the seaboard. On the other hand, the Cleveland activity in export has assisted Midland ironmakers, who have been able to serve some of the markets ordinarily catered for by Cleveland. Midland smelters agree that the revised railway rates give so little relief to the iron and steel trades that in no district will furnace owners be encouraged thereby to make a re-start. In quite a number of cases the saving effected on coke transit will not be more than 1d. per ton. Furnaces in Derbyshire and Northamptonshire which have the advantage of their ore in close proximity will get no benefit, and in other cases the saving will, at the outside, only represent a few pence per ton.

Manufactured Iron.

There is little, if any, improvement discernible, as far as best grade bar iron is concerned, in the manufactured iron trade of this district. It had been hoped that as soon as the shipyards again got going there would be considerably more work for Staffordshire ironmasters, but up to the present only the makers of second-class bars have found much advantage from the resumption. If only the engineering trade could settle to a period of peace there might be more hope of the makers of Staffordshire marked bars keeping their mills operating on full time. Marked bars continue to be quoted £13 10s. There is great dissatisfaction among Staffordshire makers on the question of prices, and a certain amount of informal consultation has taken place with a view to an understanding as to the minimum selling price of ordinary bars. While some makers claim to be getting £11 10s., material can be bought at £10 15s. The standard, however, remains £11. Orders in fair number continue to reach makers of nut and bolt bars, who are better employed than they have been for some time. Bars of this quality, of both Staffordshire and Lancashire make, can be bought at £10 2s. 6d. It is considered quite probable that even £10 would be accepted by local ironmasters if an order of, say, 200 or 300 tons was to come along. Up to now, however, this figure has not been quoted. Fencing makers, who show a disposition to buy forward, are paying £10 5s. for their bars. Belgian material for the nut and bolt trade is finding but few purchasers even at to-day's quotation of £9 5s. Local iron, more reliable in quality and quickly obtainable, has the preference. A few orders are reported to have been taken for iron strip, but they are not of much account. The top quotation now is £11 5s. A moderate business is being done by makers of galvanised sheets, the requirements of home buyers being reinforced by a fairly general export demand. Values have returned to their former range of £16 to £16 5s. for export.

Steel.

Steel prices are tolerably firm, but there is a marked slackness in the demand for finished material, and very few works are able to operate more than half-time. The maintenance of Welsh billets at £7 15s. has brought some competition from the North of England, a few parcels having been sent here at £7 10s. The price of finished bars tends to stiffen. The larger firms quote up to £9 15s., but £9 10s. is about the prevailing figure, the £9 5s. quotation gradually dropping out. Sheet bars are less active, the spurt apparently having spent itself. Tube makers are taking fair quantities of steel strip, which can be bought round about £10 5s. This is 20s. below the price asked for iron strip. A fair demand for scrap comes from South Wales, but not much business is being done in this district. Continental competition is not a noticeable feature just now, some of the foreign quotations being well above those of local works. Materials coming under Class C, which includes finished iron and steel, derive a little advantage, perhaps amounting to 3s. or 4s. per ton, from the revised railway freight charges.

Canalisation.

Following on my note last week under the head "The Development of Inland Waterways," it is of interest to note the views of Mr. Neville Chamberlain, the President of the newly formed National Council for Inland Waterways, as expressed in a recent paper dealing with inland water transport. He is of opinion that waterway improvements should proceed by steps, so that the data of each step would provide surer ground for the next advance. There must be central management and control of the water communications throughout the district comprising a group. The ownership of groups should be in the hands of a public trust directed by the various interests concerned, somewhat after the fashion of the Port of London Authority. These groups should be seven in number, with some sort of a clearing house to facilitate through running on the various systems. He would start on the Trent Navigation first. A very few years should be sufficient to demonstrate the results, and there would then be little difficulty in the formation of a second group. If these two groups were successful the general application of the policy to the main groups of waterways would be certain and rapid.

Birmingham Supplies New Minting Machines.

The French Government is installing in its mints a set of new coining presses to mint nickel-bronze coins, to replace the 50 centimes and 1*f.* and 2*f.* notes. It is interesting and pleasing to know that the fourteen presses now being supplied to the French Government for this purpose are of Birmingham manufacture. They are constructed to work at a high speed, and are capable of turning out one hundred finished coins a minute. The presses are automatically fed with blanks from a hopper, and should the feed fail they automatically stop, and this prevents the dies from being injured. Some of the presses are already at work in the Paris mint, and the remainder will be delivered before the month is out. It is of interest also to record that with the exception of Germany and Austria, coining presses manufactured by a Birmingham firm are at work in the mints of every Government.

The Engineering Dispute.

It is confidently expected in engineering circles in Birmingham that before the end of this week there will be definite developments in the direction of a complete settlement of the engineering dispute. Peace hopes have, however, so often been shattered that it is considered unwise to rely upon them now. Although the direct effect of the lock-out has been more or less negligible in the Birmingham and Wolverhampton area, in the sense that only a minute percentage of the engineers are out of the shops because the majority of local employers are in their own organisation unaffected by the A.E.U. dispute, the indirect effect of the trouble has, on the whole, been considerable. The effect is variable on the numerous concerns, but the accumulative total is a fairly serious matter. Orders are held up or delayed here and there, and business is retarded largely on account of the general unsettlement in the engineering lines. The position in Coventry is very different. The city is suffering severely from the effects of the prolonged dispute, and the output of various large firms whose names are household works is a negligible quantity. The non-federated establishments are exceptionally busy still, but the prosperity which these shops are enjoying is not commensurate with the havoc wrought to the city's industry generally. It is hoped on all sides that at last the unions concerned in the dispute will be able to recommend their members to agree to a settlement of what is regarded as a most unfortunate disagreement.

LANCASHIRE.

(*From our own Correspondents.*)

MANCHESTER, Thursday.

Iron, Steel, and Metals.

THERE is certainly some sign of improvement in the iron and metal markets this week, although no one can say that it has gone very far yet. The disposition on the part of consumers to buy, at least to a certain extent, is now stronger than it was, and more actual business is passing; but this is not saying very much, because during the last few weeks business had dwindled until there was scarcely any to be seen. It is, of course, a mistake to suppose that any rapid revival of trade can take place yet, for the hindrances in the way are great and manifold, but it will be something if industry can be started again in a small way, and if industrial peace can be secured for a few months. The failure of the Genoa conference to do anything towards the restoration of trade with Russia is no doubt depressing, but it is doubtful whether there is much disappointment, because business men here did not expect very much. What is more important is to get the European exchanges on a stable basis, and that obviously could not be done while America held aloof. America has the gold, and a gold basis for exchange is the only practicable solution in sight.

Metals.

The market for copper is certainly stronger and better than it has been for some time. Confidence in the stability of copper prices is slowly returning, and although we are not likely to see any rapid rise in prices, this confidence will be invaluable. At the present moment there is no doubt that the rate of consumption has overtaken the rate of production, so that the tendency is towards the reduction of stocks; but it will not do to rely too much on this fact, because the rate of production will increase considerably during the next three months, and we are not certain that consumption will grow to the same extent. Hence there does not seem to be any probability of the market running away, and this is satisfactory because the state of trade is not nearly good enough to support a rapidly rising market; and any attempt to force up copper prices would almost certainly lead to collapse. There is room still for some cheapening of the prices for manufactured material, more especially for locomotive and condenser tubes, but no doubt the difficulty in this matter is that the productive capacity of the works is not half employed. In other words, the cost of production is much greater than it would be if the works were fully occupied and the prices are being maintained at the expense of output. The consumption of copper in this country is not very great, but it is better in America, and would no doubt be better still if the coal strike in the country could be brought to an end. The market for tin remains fairly steady and there has been no special feature of late. The price has kept fairly near to £150 per ton, and this cannot be considered unreasonable in these times. The consumption in the engineering trades remains small, but should improve as time goes on. The call from the South Wales tin-plate trade is fairly good; but the American demand is beginning to be affected adversely by the lack of fuel. Reserves of fuel seem to be giving out, so that the coal-strike—which has now lasted nearly seven weeks—is beginning to tell. In lead there has not been very much change as yet, and the big difference between spot and forward delivery is still in existence. The settlement of the Spanish strike should soon result in larger arrivals from that source, and the opinion in the market is that spot lead will be cheaper. Spelter is fairly steady, and the demand for it is quiet. More is being used in galvanising, but the brass trade is of course taking very little.

Pig Iron.

The market here for foundry iron is not quite so dull as it was, because there is an expectation that, in spite of the various hindrances and disappointments, an actual settlement of the engineering difficulties will be reached this week. The meaning of this is taken to be that there will be a rush for engineers' castings, and that those foundries which can promise quick delivery will be very busy for a time at any rate. The supply of foundry iron here is practically confined to the Derbyshire furnaces, and although there has been some accumulation of stock at these furnaces it does not amount to very much, and a rush of demand would soon exhaust it. Buyers fear that in this case prices of No. 3 would be put up against them for a time, perhaps by 5s., perhaps by 10s. per ton; and so some of them are more inclined to buy forward at 92s. 6d. per ton delivered. That the price will be lower than 92s. 6d. within any reasonable time seems unlikely, so that the risk they take is negligible. One notices, therefore, a certain renewal of interest in the foundry iron market, such as has not been seen for a long time. Of course, if the negotiations again break down, the market will at once relapse into apathy.

Finished Material.

There is very little demand here yet for finished iron and steel. The situation is different from that in pig iron, simply because manufacturers are all hungry for orders, and it is much easier to get more production from the steel works than it is from the pig iron makers. It would take a month at least after an idle furnace was started to get really good No. 3 pig iron from it. Orders for iron and steel are in small lots, and do not tempt makers to cut the prices, so that there is no change in prices here.

Scrap.

The demand for scrap has not yet recovered to any extent. There is plenty of cast scrap about and the foundries know that they can get it at a moment's notice. Dealers still quote from £4 to £4 10s. for foundry scrap, according to quality; but one hears that there are some railway chairs to be had at 75s. per ton. The quality may not be quite so good as ordinary broken cast scrap, but for some foundry work these chairs are convenient.

BARROW-IN-FURNESS, Thursday.

Iron Ore.

The trade in hematite pig iron is about the same. Business is composed largely of orders which are small, and for only immediate requirements. As soon as there is more confidence in the country, then the orders will increase in volume and we shall have something like the old method of ordering well forward. In many cases present orders are for only hundreds of tons, whereas it used to be thousands. As far as the price is concerned there is no likelihood of that coming down. Of course transit will be cheapened. The steel works are taking a fair proportion of the present output. Pig iron continues to be shipped to home ports, and to the continent, and there is a continuance of deliveries of ingot moulds.

Pig Iron.

The pig iron trade is still only moderately employed and only on local account, and there is no sign of the Hodbarrow mines re-starting. Other local mines are engaged, but not to a very great extent. When the pig

iron trade improves the activity will naturally be reflected on the local ore trade. Foreign ore continues to come in, and two cargoes of Spanish sorts have arrived from La Felaises.

Steel.

There is an absence of anything like marked activity in the steel trade; the rail mills and the merchant mills are engaged, as also is the foundry. The best trade is still being done by the hoop mills, which continue to keep busy. There is not a very bright prospect for the steel trade on home account for some time, but it is hoped that this will develop later on.

SHEFFIELD.

(From our own Correspondent.)

A More Hopeful Feeling.

At the time of writing there is a distinctly more hopeful feeling concerning the prospects of a settlement of the engineering dispute and an early resumption of work. Certainly the fact can no longer be disguised that the great majority of the men themselves are heartily sick of their enforced idleness, and unless their leaders adopt a more reasonable frame of mind in their negotiations with the employers there will undoubtedly be a drift back to the works. Already there is a tendency in this direction, and during the present week there have been a larger number of men at work, especially on the part of those who are not directly concerned in the dispute. Thanks to the increased resistance shown by the strongly augmented police to the abuse of picketing by "mass methods," which for a time proved effective, these tactics have now been practically abandoned. A sentence of three months' hard labour for a ringleader has also had a deterrent effect. Men who wish to work can now do so unmolested. There is, however, no great volume of work waiting, and during the past week the trade of the city has dropped to the lowest ebb probably ever experienced. At the same time foreign orders and inquiries begin to show a more pleasing aspect, but these cannot be undertaken until there is a more general return to work. The steel-making plant of the city is almost at a standstill, the only export trade being in mining steel. German competition in mild steel is now insignificant, and British billets have recently stiffened. One of the most striking illustrations of the disastrous effects of industrial unrest is afforded by the experience of the Park Gate Iron and Steel Company, Limited, whose report for the year ended March last, issued early this week, discloses a loss—the amount of which is not yet ascertained—on the year's working. The company's financial year opened with the coal stoppage of last year, and for sixteen weeks not a ton of steel was produced. The blast-furnaces and the Siemens furnaces were all stopped and the linings deteriorated, and practically all of them have since had to be replaced at heavy cost. The output of ingots has been less than half that of the previous year. The one consoling feature is, however, that the works are now in the highest state of efficiency, ready to take advantage of any improvement in trade. The new 24in. section mill, which has been constructed by the Markham Engineering Company, of Chesterfield, is now nearly completed, and it is hoped will very soon be at work.

An Appeal to India.

The heavy steel and engineering trades of this district will, however, require a very big quantity of orders before anything like a return to normal activity can be made. In this connection Sheffield manufacturers are looking longingly to India, which has lately been placing some considerable orders for railway materials elsewhere. Germany, Sweden, and the United States have obtained a good deal of this business, for, acting under the explicit instructions of the Administrative Council of India, the High Commissioner has been compelled to place orders for stores in the cheapest market consistent with quality and delivery. India has recently raised a lot of new money in this country, and Sheffield manufacturers sent an influential deputation to plead with Lord Peel, the Secretary of State for India, that when such loans are arranged it should be a condition that some special consideration should be given to British firms who are in a position to supply India's needs. Lord Peel received the deputation sympathetically on Tuesday, but the political problems involved are so delicate that it is scarcely hoped that any definite outcome of the representations will result. It is more or less an open secret here that so far as Sweden is concerned, the placing of the contracts in question is regarded with some suspicion, for local steelmakers who are personally acquainted with the resources of the firms to whom the contracts have been let avow the inability of those firms to execute the orders unless they have a very substantial backing, and there is reason to believe that Krupps have certain interests involved with the Swedish firms in question.

Trade Handicapped.

Another matter on which Sheffield manufacturing interests have been seeking Government intervention is in connection with the erection of the new telephone exchange, which is to be one of the biggest and best equipped in the country, and on which work is about to be started. Local contractors have felt aggrieved that the tender has been let to the Co-operative Wholesale Society, and the Chamber of Commerce sought to make representations to the Commissioner of Works that the Co-operative Wholesale Society was advantageously placed in respect to taxation, and that ordinary firms were thereby handicapped. Lord Crawford has replied that he is not in a position to discuss questions relating to the taxation of co-operative societies, and that the Treasury alone could alter the present condition of affairs. The matter is, however, to be brought before the Associated Chambers of Commerce. Steel makers are also invoking the aid of this latter organisation in regard to railway rates. The recent reductions are regarded as totally inadequate. Steel makers contend that they have cut prices drastically in order to stimulate trade, and they are entitled to more helpful co-operation on the part of the railway companies. There is, therefore, to be a further appeal to the Railway Rates Tribunal.

Coal Costs.

Steel makers are also clamouring for further reductions in the price of coal. Mr. Charles Markham, chairman of the Park Gate Iron and Steel Company, attributes one of the causes of the failure of that undertaking to make a profit during the past year to the high cost of coal. On the other hand, the colliery companies say they cannot make any further reductions without the co-operation of the miners. In the case of one of the collieries controlled by Mr. Markham there has been an interesting development to an arrangement just arrived at between himself and the miners, who, faced with the decision to close the Barlborough Colliery announced by Mr. Markham, consented to a reduction of wages in defiance of their union. Following a severe reprimand by the general secretary of the Derbyshire Miners' Association, the local secretary offered, in order to test the feeling of the men regarding the settlement, to resign his position and submit himself to re-election if the general secretary would also resign his position and risk re-appointment. This challenge the general secretary has now announced his willingness to accept. He complains that the action of the Barlborough men in making a bargain without the cognisance of their union is already having its effect at other collieries, a neighbouring colliery having already given notices of a 7½ per cent. all-round reduction. Meantime local coal quotations show no signs of easing. Although the home demand for industrial coals is still weak, there is a considerable export business, and Yorkshire best steam hards are fetching up to 24s. Furnace coke cannot be had for much less than 20s. Carlton Main Colliery, it is of interest to note, has just issued its report for last year, showing a profit of £222,000. The Institution of Mining Engineers has accepted the invitation of the Midland Institute of Mining, Civil and Mechanical Engineers to hold the seventy-seventh general meeting at Sheffield next month. Among the papers to be discussed is one by Dr. W. H. Hatfield on "The Applications of Stainless Steel to Mining Engineering and Allied Purposes"; another on "Methods of Working the Barnsley Seam of the South Yorkshire Coalfield," by Messrs. H. and M. Rhodes; "The Air-cooling Plant at the Morro Velho Mine, Brazil," will be described by Mr. Eric Davies; "Rock Temperatures in the Coal Measures" will be dealt with by Mr. J. Ivon Graham; and "The Absorption of Carbon Monoxide by the Blood under Varying Conditions of Work," by Mr. Alfred P. Veale. Arrangements are being made for visiting works, research laboratories and collieries (including sinkings where cementation is in progress).

Trouble in the Lighter Trades.

The lighter engineering and cutlery trades are in a very poor way just now, and the prospects are not improved by the likelihood of a lock-out in the near future unless the men accept the employers' suggested reductions. All branches are suffering from a restricted demand both at home and abroad. Canada is sending very few orders, the excuse being that huge stocks which were accumulated during the boom following the war have not yet been cleared, but it is suspected that supplies are being sent by Germany and the United States. The Australian market for cutlery is showing some slight improvement, but not sufficient to relieve the position here. The pocket knife and razor makers are in the worst plight, German competition having almost killed the British trade. Local manufacturers are now turning their attention to the cheaper class of goods, for they are at last realising that buyers cannot now afford to pay Sheffield's price for superfine quality. Cutlers are under notice to terminate their present agreements at the end of this month, and no prospect of a settlement is so far discernible, though the trade is in so bad a state that conditions could not be made much worse by a lock-out.

Ferro-alloys Cheaper.

Many of the ferro-alloys are a little cheaper. Ferro-chromes have dropped £1 in the 6 and 8 per cent. carbon grades, and from £5 to £13 per ton in the purer grades, carbon-free ferro-chrome now selling at 1s. 10d. per pound. Ferro-manganese (75 per cent. silicon) has also dropped £1 per ton to £24; vanadium, molybdenum, titanium and cobalt are also a little easier.

NORTH OF ENGLAND.

(From our own Correspondent.)

Trade Crippled by Engineers' Dispute.

THE general trade position in the North of England is still very discouraging, and must necessarily remain so as long as the engineers' dispute continues. There is, however, a general confidence that the situation would rapidly improve if only a settlement of the trouble could be effected. But the unduly prolonged negotiations are undeniably holding up a considerable amount of business at a time when it is most needed, especially in the iron and steel trades. This fact is reflected in the circumstance that two blast-furnaces have been damped down this week at the Thornaby Ironworks owing to the accumulation of a large quantity of pig iron. Further information tends to discount first estimates of the benefits to the iron and steel trades under the new railway rates, which came into operation on Monday. It is now calculated that the saving in the cost of producing Cleveland pig iron will not reach 1s. per ton, and to the steel makers the saving it is thought will not exceed 5s. per ton. Indeed, in the case of the steel manufacturers some of the cuts had already been anticipated in special quotations for big lots, and the only real difference will be that the cuts now equally apply to small lots. There is thus no prospect of price cuts following the lower railway rates, the effect of which will be quite trifling.

Cleveland Iron Trade.

Extreme quietness has characterised the Cleveland pig iron market this week. In fact matters have not been so quiet for some time past. The home trade is in a state of almost complete stagnation, and the spurt in foreign business seems to have exhausted itself. What little iron is still being sold for shipment abroad is hematite, there being no demand for foundry iron, but only quite small parcels of hematite are changing hands. There is still a little trade with Germany, but no big business. Czecho-Slovakia is buying a little iron, but here the financial difficulties are an obstacle to improved trade, and the Italians are right off the mark at present. The new railway rates are now in operation, but as already explained, the concessions are too trifling to affect the price of pig iron, and the Cleveland ironmasters have not varied their selling prices, which are as follows:—No. 1 and siliceous iron, 95s.; No. 3 G.M.B., 90s.; No. 4 foundry, 87s. 6d.; No. 4 forge 85s.; and mottled and white iron 80s.

Hematite Pig Iron.

The position in the East Coast hematite pig iron trade has eased considerably. The demand is falling away, and despite the fact that there are now only thirteen hematite furnaces working as compared with fifteen a week ago, the prices are not quite so firm, and mixed numbers can now be bought at 95s. and No. 1 at 98s., which represents a further fall of 1s. per ton.

Iron-making Materials.

The foreign ore trade is extremely quiet. Sellers refuse to shade the quotation of 27s. per ton for best Rubio ore, and as buyers regard this price as too high, they are either holding off or using Mediterranean ore, which can be bought at 23s. 6d. per ton. It is interesting to note, moreover, that the import of Swedish ore has been resumed, though not as yet on a large scale. Fuel prices are no easier, but good Durham furnace coke is offered at 27s. 6d. to 28s. per ton, delivered at the works.

Manufactured Iron and Steel.

There is still no improvement to record in the manufactured iron and steel trade. Most of the mills are idle, and those that are operating are working intermittently. The home trade is utterly lifeless, only trifling orders being placed, and then buyers usually demand immediate delivery. Frequent changes of rolls add further to the cost, and makers are simply operating to find work for their men. Competition for foreign orders is very keen and prices are cut desperately low, but in the home trade manufacturers will not sell below the agreed and fixed quotations.

The Coal Trade.

The Northern coal trade position on the whole seems to have quietened down after the recent activity, and so far as can be observed, there is not much actual business under immediate discussion, although there are prospects of further contracting within the next few weeks. There are several reasons for the present apparent deterioration, the most important factor being that the output at the collieries is expanding by hundreds of thousands of tons per month, which makes the forward prospects somewhat doubtful, especially in the case of second-class coals. Then there is a dearth of orders from France, Italy, and one or two of the Scandinavian countries, together with the protracted depression in the home industrial trades. There are, however, some encouraging features, such as the heavy German purchases, the chance of American purchases on their own account, with a possible recapture of the South American and other markets in the event of the U.S.A. miners' strike proceeding. At present there are ample supplies of most kinds of coal to be had, more particularly the secondary classes, and as some of the second-hand men are compelled to clear their holdings, the market is likely to continue rather depressed until the demands from home and abroad are enlarged. There are rumours of possible heavy buying on the part of some of the South London gas and other concerns, which may steady things up a little. The Northumberland steam coal section is fairly steady for best brands, but for other classes there is not such a good demand. Almost any of the Tyne prime classes can be discounted, while for any brand of second screened steams there is little new business on offer. Smalls are fairly well upheld. Best Durham gas coals are generally firm, but other sorts are offered in abundance, and at lower prices. This is also the case in coking coals and bunkers, except for ships' use, which are still nominally at the quoted figures. There is little life in the coke market. For some of the best beehive sorts, a slightly higher price is indicated, but the trade is severely limited, while for patent oven or any kind of gas coke the market is quiet.

SCOTLAND.

(From our own Correspondent.)

Quiet—But Hopeful.

THE past week has wrought no material change in the industrial situation in Scotland. Business everywhere is dull and markets show few signs of life. In most trades producers are merely marking time, the majority of the workshops being on short time. To-day, however, there is a more hopeful feeling abroad. The engineers are about to have another meeting, which it is expected will arrive at a favourable decision. Meanwhile, trade is being held back and many orders lost. Home quotations for materials are now low enough to bring out plenty of inquiries from overseas, but the inability to state delivery is entirely against bookings. There appears little doubt that the business is there, but it is questionable if much headway could be made this side of the summer holidays, even if the trouble in the engineering trades were to be settled immediately.

Pig Iron.

Merchants still find great difficulty in doing business. Local demands are almost non-existent, and the

prices obtainable for shipments are not tempting. At any rate, the few furnaces in blast are more than equal to the demand. Nominally prices are unchanged at £5 7s. 6d. for hematite, £4 17s. 6d. for No. 1 foundry, and £4 12s. 6d. for No. 3 foundry, all per ton Glasgow delivery. The usual weekly meeting of the Glasgow pig iron "ring" again passed off without any business being done. Scotch No. 3 was quoted 90s. f.a.s. Glasgow sellers; Cleveland No. 3 90s. f.o.b. Middlesbrough sellers, and 88s. buyers; and mixed numbers East Coast hematite 96s. f.o.b. Middlesbrough sellers.

Finished Steel and Iron.

The steel works generally are still suffering from a lack of orders. Plates and sectional materials are particularly slack, and mills at no time are booked for more than a day or two ahead. Sheets have not maintained the measure of success noticeable some weeks ago owing to a slackening in the overseas demand. Black and galvanised sheets could both do with more orders. The latter are now quoted some 5s. per ton cheaper for shipment. The malleable bar ironworks are likewise poorly placed, and in many establishments few employees are in attendance, apart from the clerical staffs. Consumers everywhere are holding off despite the occasional offering of cheap prices, and it is evident that nothing much can be expected until markets are more settled.

Coal.

As in other trades, business in the coal markets is most disappointing. Prices have apparently practically touched bottom levels, but the turnover is hardly affected. The home market is stagnant and buyers are in a position to obtain advantageous terms, but are not making much use of the opportunity. The export turnover, on the other hand, shows an improving tendency and the collieries are receiving some benefit thereby. There is still considerable room for expansion however, the present demand being far from large enough to compensate for the loss of home orders. In most districts employment is irregular and, generally speaking, amounts to from three or four days' work per week. At the moment Stirlingshire is the exception to the rule. The collieries there are, in some cases, obtaining eleven days' work per fortnight. The prospect in Fifeshire and the Lothians is somewhat brighter, but in Lanarkshire the position is almost as discouraging as it could be. Aggregate shipments for the past week amounted to 290,123 tons against 265,295 tons in the preceding week and 361,598 tons in the same week in 1913. It is reported that the Danish State Railways have allotted contracts for June–August shipment, and it is said that 75,000 tons will be Scotch navigation coal. The price stated is round about 32s. 6d. per ton c.i.f.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Steam Coal Trade.

DURING the past week the steam coal market has been keenly interested in the possibilities of business being arranged for the shipment of supplies for America and Canada, but so far the period of expectancy has not been passed, as definite operations have not been concluded. Various inquiries have been circulating for coals, and firms have put forward offers for quantities estimated to amount in the aggregate to about 200,000 tons, but whether they will mature into actual business remains to be seen. When the strike of miners began in the American coalfield it was estimated that America with its reserve stocks and the output of the non-union mines would have sufficient coals until the end of next month. This being the case, exporters on this side have been pretty active, keeping in touch with the position in order to take advantage of any demands that may come along, as, of course, it would take about three weeks to load and get supplies delivered abroad. So far, it has been a matter of surprise that there has not been a more decided inquiry for anthracite coals. There are one or two for these coals for Canada, but so far as America is concerned, attention appears to be directed more to steam coals. It is reported that the price so far indicated for coals is about 30s. delivered at New York/Boston. The coals, which are calculated to work out as near as possible to the American production of "run of the mine" would be through coals. Monmouthshire or lower grade qualities could in all probability be supplied at somewhere near the figure which has been mentioned as the basis upon which business may be arranged. Coalowners here are closely following the position in the hope that the conclusion of sales will give an impetus to the market here, as the demand from other quarters abroad has not expanded to any appreciable extent. The shipowner would be equally glad to see a revival in the demand for tonnage, as the scarcity of remunerative employment appears to be getting more pronounced, with, as a result, the laying up of more steamers than ever. As regards the recent inquiry of the Danish State Railways, it is now understood that they have bought about 100,000 tons from this country, but only a very small parcel is for South Wales coals.

Miners' Federation.

In recent months a good deal of dissatisfaction has been expressed with the South Wales miners' organisation, and last week end the Executive Council, when considering the agenda for the annual conference to be held next month, gave particular attention to the proposals for the alteration of the constitution of the Federation. It was agreed when sending out the conference agenda to enclose a memorandum, pointing out that the Executive offered no opposition to a further revision of the rules, if that is thought necessary, although the whole of the rules were re-drafted, confirmed and registered as lately as December, 1920. But having regard to the unsatisfactory condition of the membership of the Federation, the Council is of the opinion that the time is very inopportune for the consideration of any fundamental change in the constitution, such as the centralisation of the whole of the administration of the Federation at the central office. The Council considers that nothing should be done to divert the attention of the workmen from the urgent necessity of restoring the Federation to its former strength and power. It also points out that the future relationship of the South Wales district with the Miners' Federation of Great Britain is in a very precarious condition, and that the efforts of all concerned in the welfare of the South Wales miners should be concentrated upon making every endeavour possible to prevent such a calamity overtaking the Federation as the severance of its connection with the miners of the other coalfields of Great Britain.

Dry Dock Industry.

Quiet times continue to be experienced in the dry dock and engineering industry in this district, and for the little amount of work that is available local firms find it very difficult to compete with other districts, especially continental repairing yards. Costs in South Wales are high, but it is satisfactory to note that the dry dock workers at Cardiff have agreed to a reduction in wages without trouble. The conditions agreed to are that a reduction of 17s. 6d. shall take effect in the existing war wage rate of 17s. 6d. in the following stages:—5s. per week in the pay week commencing June 1st next; 5s. July 6th; 4s. 6d. August 3rd; and 3s. September 7th; further, that on and from September 7th next the then existing base rate of skilled time-working trades shall be 65s. per week of forty-seven hours; semi-skilled, in accordance with the agreed—upon base rates existing—between 49s. and 65s. per week for forty-seven hours—and unskilled 49s. per week of forty-seven hours. These rates are to be stabilised for a period of twelve months to September 7th, 1923.

Current Business.

The tone of the steam coal market displays comparatively no change, and in view of the near approach of the Whitsuntide holidays and the loss of output, it is not expected that there will be any developments for a few weeks. The demand is on very moderate lines, so far as the general inquiry from France and Italy is concerned, but still shipments continue to be well maintained. Best Admiralty large are about 28s. 3d. to 28s. 6d., and second grades are obtainable at 27s. 9d. to 28s. Monmouthshire coals are moving off fairly well, and the better descriptions of smalls keep pretty steady on the basis of 19s. 6d. Patent fuel makers are in the majority of cases well off for orders, and prices range from 25s. 6d. to 28s. 6d. Anthracite coals, with the exception of duff, and possibly beans, are quite firm, and coalowners are only quoting for supplies for very prompt shipment. They decline to entertain business ahead in the belief that present prices will in all probability be improved upon. Best anthracite large is quoted at 50s., and second qualities at 45s., while best nuts and cobbles are firm at 55s.

Latest News from the Provinces.

WALES AND ADJOINING COUNTIES

Swansea Docks.

THE Executive Committee of the Swansea Harbour Trust has approved of the proposed arrangement for the transfer to the Great Western Railway Company of the undertaking. It is understood that the terms of transfer are an exchange of stock on the basis of £80 of 5 per cent. guaranteed Great Western stock for every £100 Swansea Harbour 4 per cent. stock, the company, in addition, to pay off all arrears of interest and meet all other liabilities.

Metal Market.

The tin-plate trade at Swansea is quiet, and prices are easing down. Makers declare if prices continue to fall it will result in works closing.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

WE are asked to state that Mr. Charles L. MacCarthy, formerly with Stewarts and Lloyds, Limited, has opened offices at 48, Foster's-buildings, Sheffield, and will represent with others throughout the coalfields of Yorkshire, Derbyshire and Nottinghamshire, Milner Hurd's Patents Company, Limited, of 4, Paradise-square, Sheffield.

J. E. WESTLE AND CO., specialists in linoleum, cork breaking, granulating and sifting machinery, cork slab plants, &c., ask us to state that they have opened an office at Eastgate House, Gloucester. Telephone number 93 Gloucester and telegraphic and cable address "Westlin, Gloucester."

THE London office of the Hoffmann Manufacturing Company, Limited, has been removed from 59, New Oxford-street, to 8, Bedford-square, W.C. 1. The telephone number and telegraphic address remain as before, viz., 529 Museum and "Hoffmannly, Westcent."

FLOW METERS.—We have been asked to state that the total current consumption of the indicating, integrating and recording instruments described on page 545 of our last issue is 1 ampère, and not 3 ampères as stated.

THE PROFESSIONAL CLASSES AID COUNCIL.—This Council was established to help persons connected with the professional classes who suffered through the effects of the war. One of the directions in which it has worked is the provision of education for children dependent upon professional workers and in the making of grants during illness. Many engineers have benefited by it, and regret will be felt that owing to financial difficulties it is now obliged to refuse applications for assistance. An appeal is therefore being made to engineers for subscriptions, which may be sent to the secretary of the Council at 251, Brompton-road, S.W. 3.

CATALOGUES.

ROWESON, DREW AND CLYDESDALE, Limited, 225, Upper Thames-street, E.C. 4.—We have received a copy of the firm's new loose-leaf catalogue of elevators and conveyors.

RUSTON AND HORNSBY, Limited, Lincoln.—This firm has just issued a pamphlet, entitled "Ruston Boilers for Collieries." Illustrations of several types of boiler are reproduced.

KINGSBURY MACHINE WORKS, Philadelphia, Penna.—A copy of Catalogue C, January, 1922, on "The Kingsbury Thrust Bearings." The principle operation of the bearing is described with illustrations of its application.

H. C. SLINGSBY, 142–146, Old-street, E.C. 1.—A copy of design chart No. 197, which illustrates the great number of articles which this firm produces. Over three hundred different designs of trucks are shown on this folder.

ATELIERS DE CONSTRUCTIONS ELECTRIQUES DE CHARLEROI, 56, Victoria-street, S.W. 1.—A copy of the quarterly bulletin, No. 94, is to hand. Articles appear on electric winding engines, high-lift centrifugal pumps and condensers for power factor improvement.

FOUNDRY PLANT AND MACHINERY, Limited, 28, Royal Exchange-square, Glasgow.—The Beardsley-Piper sand slinger moulding machine is described and illustrated in a new pamphlet issued by the firm. It has been specially designed for use in foundries.

THE MIRRLEES WATSON COMPANY, Limited, Scotland-street, Glasgow.—A copy of the firm's new ejector air pump booklet, which gives a general description of the Mirrlees steam multi-jector air pump of the central condenser type. There are a few illustrations of the plants given.

BURTON, GRIFFITHS AND CO., Limited, 70, Vauxhall Bridge-road, S.W. 1.—An illustrated wall calendar printed in two colours with monthly tear-off sheets. On each sheet a print of a machine of some description appears, with a short note on the subject. The calendar extends to March, 1923.

THE ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS, of 166, Piccadilly, W. 1, has just published a new list entitled "Some British Fine Chemicals Produced by Members of the Association." Applications for this list should be addressed to Mr. W. J. U. Woolcock at the above-mentioned address.

J. H. HOLMES AND CO., Portland-road, Newcastle-on-Tyne.—The firm has just published a new catalogue on alternating-current induction type motors. In addition to general information, comprehensive tables of outputs are included. Many interesting tables and illustrations have been embodied in this catalogue.

HANDLEY PAGE TRANSPORT, Limited, London Terminal Aerodrome, Croydon, Surrey.—An exceedingly well-produced wall calendar from 1922–1924. The picture is a reproduction oil painting of an aeroplane in full flight just arriving over the coast line. It has been executed by Raphael Tuck and Sons, Limited, London.

EASTERN GROUP OF RAILWAYS, GREAT NORTH OF SCOTLAND RAILWAY.—A list of holiday resorts on the company's system has been received. Hotels, boarding-houses and apartments available for visitors in districts served by the company has been compiled for the 1922 season. A map of the Great North of Scotland Railway is reproduced.

MANLOVE, ALLIOTT AND CO., Limited, Bloomsgrove Works, Nottingham.—A new edition of the hydro-extractor or centrifugal catalogue No. 512 is to hand. A wide range of hydro-extractors suitable for the various trades using such apparatus is described and illustrated.

ROTAX (MOTOR ACCESSORIES), Limited, Rotax Works, Willesden Junction, N.W. 10.—A copy of the latest catalogue on Newton's direct-current motors and generators, which firm is incorporated in Rotax, Limited. Besides a general description of these machines, many illustrations are included. A large number of tables have been embodied in the pamphlet.

BARRY, HENRY AND COOK, Limited, Aberdeen.—This firm, who specialise as "transmission engineers," has just issued a new catalogue. All classes of lifts, cranes, winding and haulage gears with conveyors are dealt with in this catalogue. Also a summary of machinery for the transmission of power is included. A very fine selection of illustrations is embodied in the book.

THE RELAY AUTOMATIC TELEPHONE COMPANY, Limited, Marconi House, W.C. 2.—A copy of a pamphlet, entitled "Notes on Automatic Telephony," which sets out some of the advantages of automatic telephones. A copy of an exceptionally well-produced brochure, entitled "The Relay Automatic Telephone System." Illustrations of the installations supplied by the company are reproduced and many of the main parts are shown separately.

THE BRITISH REINFORCED CONCRETE ENGINEERING COMPANY, Limited, 1, Dickinson-street, Manchester.—This firm has just issued a very interesting book entitled "B.R.C. Roads." A photographic record is shown of the use of reinforced concrete in modern road construction. Besides the photographs, which are exceedingly well reproduced, a B.R.C. road specification is included. The book is very well got up, and the binding is in dark leather with gold lettering.

THE DORLAND AGENCY, Limited, 16, Regent-street, S.W. 1.—A copy of "The Zone and Population Map of the British Isles" has just been received. The map has been revised up to date in accordance with the Census figures of June, 1921. Circles are drawn from various important towns of 25, 50, 75, and 100 miles radii, with the present population placed in small figures under the name of the town. Copies of this map may be obtained at 1s. 3d. each from the Dorland Agency, Limited.

HOLLINGS AND GUEST, Limited, Thimble Mill-lane, Birmingham.—A copy of list No. A102 is to hand, the subject being hydraulic baling presses for ground nuts and other seeds. The plant is of a simple character and can be worked satisfactorily by native labour, and the reduction in bulk is as much as 50 per cent. when this method is adopted, whilst decomposition is less liable than when seeds are shipped in their loose state. A film has been produced which shows the whole baling process, and may be seen in London on application to the firm.

CLEWORTH, WHEAL AND CO., Limited, Grange Engineering Works, Trows-lane, Castleton, near Manchester.—This firm has just issued a small booklet on "The Wet and Dry Bulb Thermometer." The booklet contains a complete set of hygrometrical tables for wet and dry bulb temperatures. The temperature of the dew point, the elastic force of vapour, the weight of vapour in a cubic foot of air, &c. The tables are published by permission of Professor Jas. Glaisher, F.R.S. The book will prove useful to anyone who has to deal with atmospheric conditions in factories, mills, stations, cinemas, and patent food factories.

GEORGE KENT, Limited, 199-201, High Holborn, W.C. 1.—"Irrigation Appliances" is the title to a new publication issued by the firm. These appliances are manufactured by the above-mentioned firm and J. Blakeborough and Sons, Limited, of Brighouse—meters and modules by the former and sluice valves and sliding gates by the latter. Much detailed information—some of historical note—has been embodied in a preface, which must have taken some little while to compile. Many different types of apparati are illustrated and described.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	28/-
(1) Spanish	28/-
(1) N. African	28/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	27/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(3) SCOTLAND—		
Hematite	5 5 0	—
No. 1 Foundry	4 17 6	—
No. 3 ,,	4 12 6	—
N.E. COAST—		
Hematite Mixed Nos.	4 15 0	4 15 0
No. 1	4 16 0	4 16 0
Cleveland—		
No. 1	4 15 0	4 15 0
Silicious Iron	4 15 0	4 15 0
No. 3 G.M.B.	4 10 0	4 10 0
No. 4 Foundry	4 7 6	4 7 6
No. 4 Forge	4 5 0	4 5 0
Mottled	4 0 0	4 0 0
White	4 0 0	4 0 0
MIDLANDS.		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
Part Mine Forge	*None offering.*	
North Staffs. No. 3 F'dry	4 5 0 to 4 10 0	
(3) Northampton—		
Foundry Nos. 2 and 1	*Nominal.*	
,, No. 3	4 0 0	—
,, Forge	3 10 0 to 3 12 6	
(3) Derbyshire—		
No. 3 Foundry	4 2 6 to 4 5 0	
Forge	3 12 6 to 3 15 0	
(3) Lincolnshire—		
Basic	4 0 0 to 4 5 0	
Foundry	4 5 0 to 4 10 0	
Forge	4 2 6 to 4 5 0	
(4) N.W. COAST—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	5 15 0	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	11 0 0	10 15 0
Best ,,	12 0 0	—
N.E. COAST—		
Crown Bars	12 0 0	—
Tees	14 10 0	—
LANCS.—		
Crown Bars	11 10 0	—
Second Quality Bars	10 5 0	—
Hoops	14 0 0	13 15 0
S. YORKS.—		
Crown Bars	12 0 0	—
Best ,,	13 0 0	—
Hoops	14 0 0	—
MIDLANDS—		
Marked Bars (Staffs.)	13 10 0	—
Crown Bars	11 10 0	—
Nut and Bolt Bars	10 5 0	—
Gas Tube Strip	11 10 0 to 11 15 0	
Hoops (*Nom.*)	14 0 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	14 0 0	—
Ship Plates ⅜in. and up	10 10 0	—
Sections	10 0 0	—
Steel Sheets ¼in. to ⅜in.	11 15 0	—
Sheets (Gal. Cor. 24 B.G.)	—	16 5 0

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	10 10 0	—
Angles	10 0 0	—
Boiler Plates	14 10 0	—
Joists	10 10 0	—
Heavy Rails	9 10 0	—
Fish-plates	14 10 0	—
Channels	14 10 0	—
Hard Billets	8 15 0	—
Soft Billets	7 15 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 10 0	—
Light ,,	11 0 0 to 13 0 0	
Billets	9 5 0	—
Ship Plates	10 10 0	—
Boiler ,,	14 10 0	—
MANCHESTER—		
Bars (Round)	10 0 0 to 12 0 0	
,, (others)	11 0 0 to 12 0 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	12 5 0	12 0 0
Plates	£10 to 12	10 0 0
,, (Lancs. Boiler)	16 0 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0 to 11 0 0	
Bessemer Billets	12 10 0	—
Hard Basic	9 5 0 to 9 10 0	
Soft ,,	7 15 0	—
Hoops	12 5 0	—
Soft Wire Rods	11 0 0	—
MIDLANDS—		
Small Rolled Bars	9 5 0 to 9 10 0	
Bessemer Billets	7 12 6	—
Hoops	11 15 0 to 12 0 0	
Gas Tube Strip	10 5 0 to 10 10 0	
Sheets (24 W.G.)	12 10 0	—
Galv. Sheets (f.o.b. L'pool)	16 0 0 to 16 10 0	
Angles	10 0 0	—
Joists	10 10 0	—
Tees	11 0 0	—
Bridge and Tank Plates	10 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/- to 19/6
Block Tin (cash)	149 15 0
,, (three months)	151 5 0
Copper (cash)	62 2 6
,, (three months)	62 10 0
Spanish Lead (cash)	25 2 6
,, (three months)	23 10 0
Spelter (cash)	27 5 0
,, (three months)	27 2 6
MANCHESTER—	
Copper, Best Selected Ingots	68 0 0
,, Electrolytic	70 0 0
,, Strong Sheets	90 0 0
,, Loco Tubes	0 1 1¼
Brass Loco Tubes	0 0 11½
,, Condenser	0 1 2½
Lead, English	26 10 0
,, Foreign	25 7 6

FERRO ALLOYS.

(*All prices now nominal*).

	Per Ton.	Per Unit
Tungsten Metal Powder	1/6 per lb.	
Ferro Tungsten	1/4 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£27	10/-
,, 6 p.c. to 8 p.c. ,,	£25 10 0	9/-
,, 8 p.c. to 10 p.c. ,,	£24 10 0	8/-
,, Specially Refined		
Max. 2 p.c. carbon	£65	26/-
,, 1 p.c. ,,	£80	32/-
,, 0·75 p.c. carbon	£90	37/-
,, carbon free	1 10 per lb.	
Metallic Chromium	5/3 per lb.	
Ferro Manganese	(per ton) £15 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£13 0 0 scale 5/- per unit	
,, ,, 75 p.c.	£24 10 0 scale 6/- per unit	
,, Vanadium	18/- per lb.	
,, Molybdenum	6 6 per lb.	
,, Titanium (carbon free)	1 2 per lb.	
Nickel (per ton)	£180	
Cobalt	12/ per lb.	
Aluminium (per ton)	£110 to £120 (British Official).	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	20 6
,, ,, Ell	20/3
,, ,, Splint	21 6 to 23,6
,, ,, Trebles	19 6
,, ,, Doubles	18 6
,, ,, Singles	17 6
AYRSHIRE—	
(f.o.b. Ports)—Steam	20/-
,, ,, Splint	21 6
,, ,, Trebles	19 6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	18/- to 22/-
Screened Navigation	26 6
Trebles	19 9
Doubles	18 9
Singles	18 6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	20/-
Secondary Steam	19 6
Trebles	19 9
Doubles	18 9
Singles	18/-

ENGLAND.

	Export.
(3) N.W. COAST—	
Steams	33/-
Household	40/- to 55/-
Coke	34/-
NORTHUMBERLAND—	
Best Steams	22 6 to 24/-
Second Steams	21/6 to 22/-
Steam Smalls	13/- to 15/-
Unscreened	20/6
Household	25/- to 30/-
DURHAM—	
Best Gas	22/6 to 23/-
Second	20 - to 21 6
Household	25/- to 30/-
Foundry Coke	32,6 to 35/-

	Inland.
SHEFFIELD—	
S. Yorks. Best Steam Hards	23/- to 24/-
Derbyshire Hards	21/- to 22/-
Seconds	20/- to 21/-
Cobbles	20/- to 21/-
Nuts	18/- to 19/-
Washed Smalls	11/- to 12/-
Best Hard Slacks	12/- to 13/-
Seconds ,,	10/- to 11/-
Soft Nutty ,,	7/6 to 8 6
Pea ,,	7/- to 8/-
Small ,,	2/- to 4 6
House, Branch	37/- to 39/-
,, Best Silkstone	34/- to 36/-
Blast Furnace Coke (Inland and Export)	19/- to 21/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	28/- to 28/6
Second ,, ,,	27/6 to 28/-
Best Dry Large	26/6 to 27,6
Ordinary Dry Large	25 - to 25,6
Best Black Vein Large	27/- to 27/6
Western Valley ,,	26 6 to 27/-
Best Eastern Valley Large	26/6 to 27/-
Ordinary ,, ,,	24/6 to 25/6
Best Steam Smalls	19/- to 19 6
Ordinary ,,	15/- to 19/-
Washed Nuts	25/- to 26/-
No. 3 Rhondda Large	28/- to 29 -
,, ,, Smalls	19/6 to 20/-
No. 2 ,, Large	23/- to 24/-
,, ,, Through	19/- to 20/-
,, ,, Smalls	15/- to 16 -
Coke (export)	34/- to 35 -
Patent Fuel	25 6 to 28 6
Pitwood (ex ship)	31 - to 31 6
SWANSEA—	
Anthracite Coals:	
Best Large	47 6 to 52 6
Seconds	42 6 to 45/-
Red Vein	32 6 to 35/-
Big Vein	42 6 to 47 6
Machine-made Cobbles	52/6 to 55/-
Nuts	52 6 to 55 -
Beans	42 6 to 45/-
Peas	24/- to 26/-
Breaker Duff	9/- to 9 6
Rubbly Culm	16 6 to 17/-
Steam Coals:	
Large	22/6 to 24/6
Seconds	20 - to 22 6
Smalls	14 - to 16/-
Cargo Through	18 - to 20 -

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England.

(7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

French Engineering Notes.

(From our Correspondent in Paris.)

Cotton Growing.

In the belief that the African colonies will in time supply all that is required in cotton and other produce on condition of there being a suitable organisation and adequate transport facilities, this country has embarked upon the construction and equipment of ports, the laying down of railways, and the building of roads, which will eventually open up the west of Africa as far as the Niger Valley. This is part of a scheme that is to render France almost entirely self-supporting. She already grows her own grain and produces more raw iron than she needs. The coal output is about two-thirds of the home requirements, and in view of the hydraulic power available, it is expected that when all the hydro-electric proposals are carried out, there will be no longer any necessity to import coal at all. It is believed that the participation of France in the oil production of Eastern Europe and Asia Minor will assure her of sufficient supplies of liquid fuel, and the only raw material for which France is likely to be dependent upon foreign countries is cotton, which, however, can be grown in such quantities, it is believed, in the Niger Valley that the colonies may be able to produce more than is necessary for home requirements. The various financial institutions interested in the opening up of the colonies have constituted a group known as the Société Générale des Colonies, which is sending out to the Niger Valley American and Egyptian cotton experts, as well as a commission of scientists, who will investigate the most suitable conditions under which cotton can be grown. For a long while past two experimental plantations have been at work between Timbuctoo and Bamako, separated by about 800 kiloms., and the cotton grown is said to be fully as good in quality as the Egyptian. Before the industry can be established, however, a vast amount of irrigation work will have to be carried out, with an extensive system of canals supplied with water from a long distance up the Niger, and as the lower part of the river is not suitable for navigation, on account of the rapids, it is probable that everything will have to be carried overland. The question of labour will also have to be seriously considered, for the heavy mortality, except in some districts, keeps the number of the native population very low, and it is hoped to remedy this with hygienic improvements.

Collieries.

The work of unwatering and reconstituting the collieries in the Nord is making good headway with the aid of funds procured by the public loan which the group of colliery companies issued several months ago. The destruction was so complete that the task of putting the collieries in order has often been very difficult, especially in view of the quantity of water coming through fissures in the chalk strata. Powerful pumping plants are at work, and at the Liévin collieries nearly one-half of the total quantity of thirteen and a-half million cubic metres of water has been raised, while, despite the twenty-three pumps in operation at the Lens collieries, it is not expected that the mines will be completely unwatered before the end of 1923. The total cost of reconstituting the Lens collieries is estimated at 600 million francs. At Bethune the work of repairing the shafts which the Germans destroyed by explosives is very difficult and arduous through the necessity of injecting cement under pressure in the water-bearing strata. Besides putting the mines in working order, the companies have had to build many thousands of homes for the men and their families, and not only has every man to be provided for on account of the destruction of Lens and other colliery towns, but the number of hands has been considerably increased by the operation of the eight hours' day. At Lens alone it will be necessary to build from 12,000 to 15,000 houses.

Rolling Stock.

In 1919, orders were distributed amongst sixteen firms for 1625 coaches and 700 vans, and before the work could be proceeded with prices of raw material started on an upward movement, which is even now slightly accentuating, and the wagon builders therefore appealed to the Minister of Public Works for a revision of the contract prices, which they affirmed would entail a serious loss. The Minister could not see his way to change prices which had been accepted by the wagon builders, and the latter refused to carry out the contract, or at least delayed its execution in the hope that it would be possible to come to some arrangement. After two and a-half years of negotiation the Minister of Public Works has now agreed to increase the original contract price by a coefficient which varies from 1.33 to 1.4725, according to the class of vehicle, and the builders have undertaken to deliver the whole of the material by the end of March next year.

Wages.

In the engineering trades in the Nord employers declare that it is quite impossible to continue operations unless the men accept a reduction in wages, for the competition from Belgium has become so keen since wages were reduced in that country that it is very difficult for French firms to secure business, and in most cases they state that they have been unable to make any profit on the orders obtained. There has been no appreciable drop from the high wages level, and as the eight hours' day has diminished the production per man by something like 20 per cent., the manufacturing cost is far too high in view of the growing competition, and engineering firms in the Lille district therefore advised the men that they must either accept a reduction in wages or the majority of works would have to be closed. Notwithstanding the offer of employers to prove that they were no longer in a position to pay the present rates, the men refused to accept any reduction, and during the past week a strike was declared, which has already assumed such large proportions that it is feared the entire industrial activity of the Lille district will be disorganised.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM ENGINES.

178,330. April 20th, 1921.—GOVERNING GEAR, W. H. Allen and Co., Limited, Bedford, H. Oxlin, Cumberland-road, Leagrave, and A. D. Harrison, the Cottage, Beverley-crescent, Bedford.

In this governor a lever A is pivoted at B and has one end connected to a rod C actuating the throttle valve and the other end to the piston-rod D of a piston which is constantly pressed downwards by a spring F in an oil cylinder E. A valve G controls the passage of oil from the cylinder E, and in Fig. 1 the valve G also controls the flow of oil which passes through a pipe H and a passage I to the cylinder E. In Fig. 2, however, the oil supply H opens directly to the cylinder E, and in this case the flow of oil is in one direction only. A floating lever J has one end connected to the piston-rod D and the other end to the stem of the valve G, the position of the lever being regulated

No 178,330

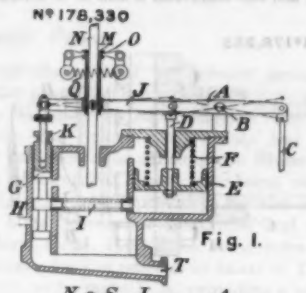


Fig. 1.

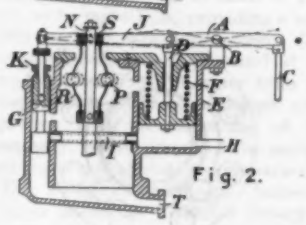


Fig. 2.

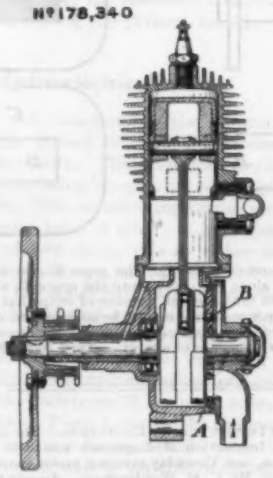
by the stem of the valve G, which is formed in two parts screwing into one another and locked by the nut K. In Fig. 1, a sleeve M on the governor spindle N is connected to the floating lever J, and is actuated by the ends O of two bell-crank levers upon whose other ends are weights connected together by a spring Q. When the speed of the engine increases, the ends O of the bell-crank levers depress the sleeve M and the lever J and also the valve G, thus allowing oil to escape from the cylinder E. In Fig. 2, weights P are carried by leaf springs R, and are connected to a die S through which the governor spindle N passes. The die S is connected to the floating lever J which, as before, is depressed when the speed of the engine increases. The exhaust oil in both cases passes to an outlet T.—*April 20th*, 1922.

INTERNAL COMBUSTION ENGINES.

178,340. May 2nd, 1921.—TWO-STROKE ENGINES, The Valveless Two-stroke Engine Company, Limited, 303, Broad-street, Birmingham, and J. Duffy.

The inventors employ a ported disc A to control the inlet

No 178,340



from the carburetter to the crank case. The disc is held up against the crank case by a spring B and is driven off the crank shaft by a peg fitting loosely in a hole.—*April 20th*, 1922.

DYNAMOS AND MOTORS.

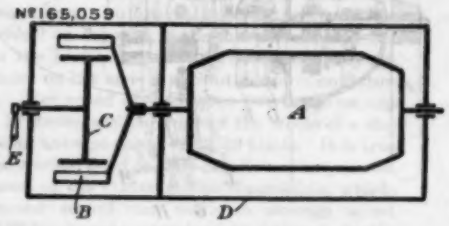
167,778. August 12th, 1921.—IMPROVEMENTS IN AND CONNECTED WITH THE COOLING OF ELECTRIC GENERATORS DRIVEN BY STEAM TURBINES, The Oerlikon Company, of Oerlikon, near Zurich, Switzerland.

It has been proposed to pass the cooling air supplied to turbo-generators through a water cooler in a closed circuit, and according to this invention the cooling water is supplied by the same pump that deals with the circulating water of the condenser. In the event of it being necessary to run the turbine non-condensing on account of the pumps or condenser being out of order, the cooling air can be taken in and discharged in accordance with the usual method.—*April 20th*, 1922.

165,059. November 11th, 1920.—IMPROVEMENTS IN DYNAMO ELECTRIC MACHINES, Robert Bosch Aktiengesellschaft, of 4, Militarstrasse, Stuttgart, Germany.

The dynamo A which provides the lighting current for a motor car is driven directly or indirectly from the crank shaft of the engine. A magnet system B for the ignition is mounted on the dynamo shaft and rotates with it. A stationary armature C is

No 165,059



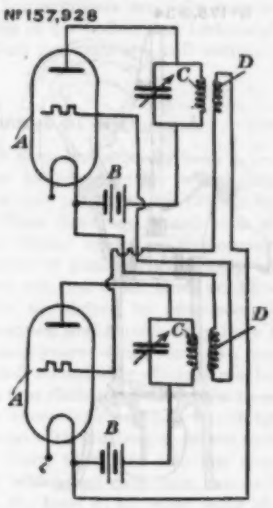
mounted in the case D, which encloses both machines. The stationary armature C can be turned through a certain angle by means of the handle E, for the purpose of timing the sparking. The contact breaker, condenser and distributor may be arranged as desired. The specification also describes a method of adjusting the spark timing automatically.—*April 11th*, 1922.

WIRELESS TELEGRAPHY.

157,928. January 10th, 1921.—IMPROVEMENTS IN OR RELATING TO THERMIONIC OSCILLATION GENERATORS, PARTICULARLY FOR WIRELESS SIGNALLING, Dr. Erich F. Hutch, G.m.b.H., of 130–132, Wilhelmstrasse, Berlin, S.W. 48, and Bruno Rosenbaum, of 130–132, Wilhelmstrasse, Berlin, S.W. 48, Germany.

The object of this invention is to secure constancy and regularity in the oscillations produced by parallel-operated thermionic valves. In the drawing the valves are shown at A. The batteries which provide the current for the oscillatory circuits

No 157,928



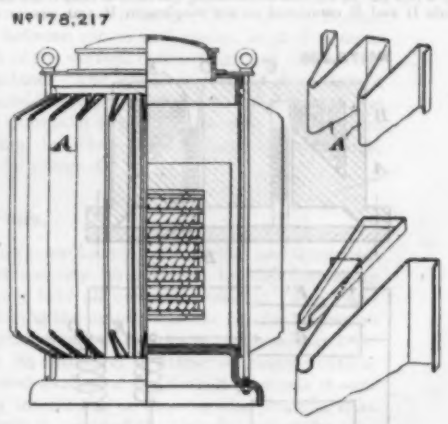
are shown at B, whilst the oscillating circuits are shown at C. The heating batteries are not illustrated. By connecting the grid circuit of one valve with the oscillatory circuit of the other by means of induction coils D the desired object is secured.—*April 10th*, 1922.

TRANSFORMERS.

178,217. January 18th, 1921.—IMPROVEMENTS IN AND RELATING TO CASINGS FOR ELECTRICAL APPARATUS, *The British Thomson-Houston Company, Limited, of* 83, *Cannon-street*.

According to this invention the corrugated walls A of transformers are formed of sheet metal units, preferably having two or more corrugations, which are made by simple shearing and

No 178,217



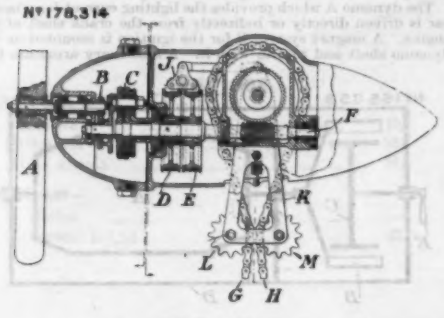
bending operations without the aid of drawing processes involving the use of expensive dies. The spaces formed by these corrugations are closed at the ends by separately inserted end pieces as shown on the right, and all the parts are welded together.—*April 18th*, 1922.

TRANSMISSION OF POWER.

178,314. April 9th, 1921.—A SERVOMOTOR FOR AIRCRAFT, The Fairey Aviation Company, Limited, Cranford-lane, Hayes, Middlesex, and C. R. Fairey.

This specification covers a servomotor, or mechanical relay,

for assisting the pilot in controlling an aeroplane. A windmill A provides the power, and is connected, by means of speed-reducing gearing B, with the double sun-and-planet gear C. The sun wheels of this gear are controlled by the two brake drums D and E, and are so proportioned that they produce rotation in opposite

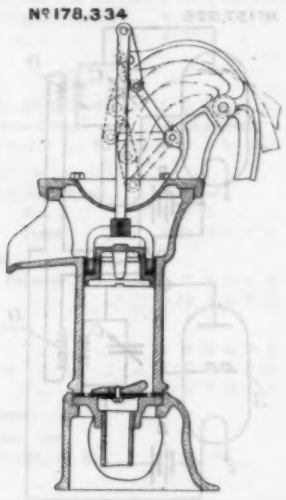


directions of the worm shaft F, which operates the control chains G, H. The brake bands of D and E are applied by the bell-crank lever J, which is connected with the frame K carrying the two sprockets L and M. If, for instance, the chain H is tightened by the pilot moving the ordinary hand control of the aileron to which it is attached, the sprocket M will be moved to the right, the bell crank J to the left and the brake E will be applied, with the result that the windmill will drive the main chain sprocket in a counter-clockwise direction, and thus assist the pilot. A similar action, in the reverse direction, takes place when the chain G is tightened.—*April* 20th, 1922.

PUMPING AND BLOWING MACHINERY.

178,334. April 27th, 1921.—A STRAIGHT MOTION PUMP, Kurasuke Saeki, 17, Rokuchome, Aoyama Minamichom Akasakaku, Tokyo, Japan.

A claim is made in this specification for the straight line

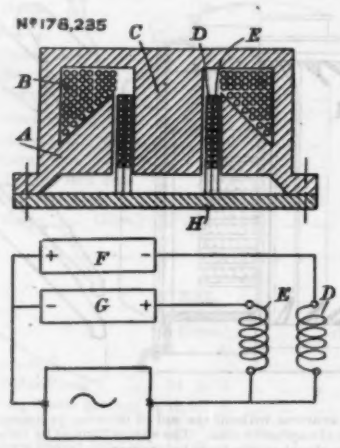


motion shown in the drawing, the action of which is obvious, but the relative proportions of the various links are not given.—*April* 20th, 1922.

MISCELLANEOUS.

178,235. January 28th, 1921.—IMPROVEMENTS IN OR RELATING TO ELECTRO-MAGNETIC VIBRATING DEVICES, ESPECIALLY FOR SOUND TRANSMISSION, Dr. Willy Kunze, of Contrescarpe, 190, Bremen, Germany.

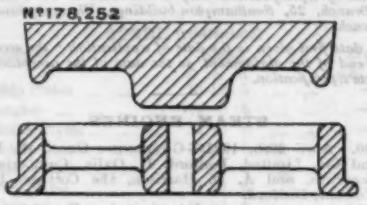
This invention is of special importance in connection with transmitters for submarine sound transmission, for which a relatively high note has proved to be an advantage. In the drawing, A indicates an annular magnet which is energised by a coil B. In the slot surrounding the central boss C are two coils D and E connected to the diaphragm H and wound in



opposite directions. To these coils an alternating current is supplied in the manner shown in the lower drawing. The distribution of the alternating impulses is effected by means of current rectifiers F and G, one of which allows only positive-current impulses to pass through the coil D, and the other allows only negative impulses to pass through the coil E. If a mercury vapour rectifier is employed, the two coils D and E are connected to the anode and cathode respectively, either directly or by means of a transformer.—*April* 20th, 1922.

178,252. February 11th, 1921.—A DROP FORGING PROCESS, Steels and Refractories, Limited, Orchard Chambers, Church-street, Sheffield.

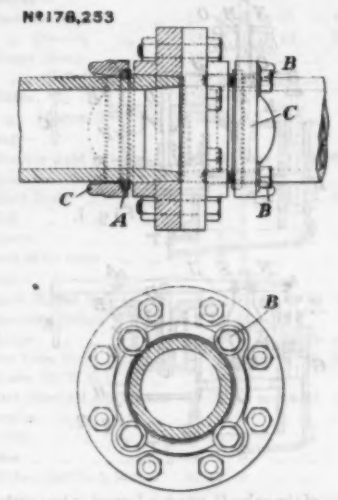
In this specification a claim is made for "a process for the manufacture of drop forgings of the type described characterised in that a rough 'use' is cast which sufficiently approximates the finished article in shape to allow the metal to flow into every part of the dies when being forged, the 'use' being cast in an



open chill with a substantially flat top with the underside specially formed to ensure the material flowing in the bottom forging die." It is claimed that the resulting forging will "give the desired tests." The illustrations show a typical cast "use" and the wheel made from it.—*April* 20th, 1922.

178,253. February 15th, 1921.—PIPE JOINTS, H. Slade and E. Green and Son, Limited, Wakefield.

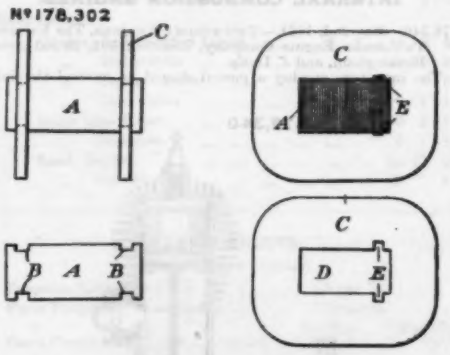
This pipe joint is primarily intended for fuel economisers and such services. The flanges are forced on to tapers on the ends of the pipes, and this connection is said to be sufficient for all



ordinary pressures. For higher pressures split rings A are sprung into grooves in the ends of the pipes and the flanges held by set screws B B and plates C bearing against the split rings.—*April* 20th, 1922.

178,302. March 23rd, 1921.—IMPROVEMENTS RELATING TO BOBBINS FOR USE IN ELECTRO-MAGNETIC APPARATUS, Ernest Ansley Watson and the M.I. Magneto Syndicate, Limited, all of Victoria Works, West Orchard, Coventry.

This invention relates to bobbins for use in electro-magnetic apparatus. The iron strips A which form the laminated core are provided with notches B, whilst the cheeks C of the bobbin are provided with apertures E, and the bobbin is made by inserting



the strips E endwise through the gaps E and moving them longitudinally along the cheeks into the space D, this operation being continued until the full number of strips has been packed in position. In some cases it may be sufficient to rely upon the tight packing of the strips, but if necessary the plates can be held firmly together by means of a rivet.—*April* 20th, 1922.

THE JUNIOR INSTITUTION OF ENGINEERS.—The annual dinner of the Junior Institution of Engineers was held at the Café Monico, London, last Thursday evening, under the chairmanship of the president, Mr. C. H. Wordingham. Among those present were the presidents of the Institutions of Civil and Mechanical Engineers, Mr. C. H. Worthington and Dr. H. S. Hele-Shaw, Professor E. G. Coker, Dr. W. H. Eccles, and Mr. W. A. Tookey. The Junior Institution was founded in 1884 by a few apprentices at the Lambeth works of Maudslay, Sons and Field, but has since far outgrown in size and scope anything originally contemplated for it by its founders. It is still, however, distinguished by the fact that it is infused with a junior spirit, although many of its members are also members of the senior institutions. It has now over two thousand names on its roll and has branches in several parts of the country, as well as one in Australia and one in Assam. In addition to the reading and discussion of full-length papers, it makes a feature of Friday evening informal meetings, visits to works and social functions. The fourth Gustavo Canet lecture is to be delivered on June 1st by Sir Eric Geddes, the subject of his discourse being "The Railway Act of 1921."

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

THE INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Eastern District meeting, at Town Hall, Dyne-road, Kilburn. 10.30 a.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Discourse, "The Internal Combustion Engine: Its Influence and its Problems," by Professor W. E. Dalby, B.Sc. 9 p.m.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—Armstrong College, Newcastle-on-Tyne. First general meeting. Paper, "Some Problems in a Brass Foundry," by Messrs. O. Smalley and S. G. Homfray. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—Caxton Hall, Westminster, S.W. 1. Lecturette, "Engineering Appointments and How to Get Them," by Mr. J. Cameron Rennie. 8 p.m.

ROYAL SOCIETY OF ARTS: INDIAN SECTION.—John-street, Adelphi, W.C. 2. Sir George Birdwood Memorial Lecture, "Indian Painting and Muhammadan Culture," by Sir T. W. Arnold. 4.30 p.m.

WOMEN'S ENGINEERING SOCIETY.—26, George-street, Hanover-square, W. Third annual general meeting. Business meeting, 6.15 p.m. Paper, "Wireless Telegraphy," with demonstrations, by Mr. H. R. Rivers-More, B.Sc., 7 p.m.

SATURDAY, MAY 27TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Whole-day visit of the London Graduates to the works of Cubitt's Engineering Company, Limited, Aylesbury. 8.50 a.m. train from Baker Street Station.

INSTITUTION OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Visit to the Staveley Coal and Iron Company's works at Staveley. Train leaves Manchester (Central Station) 8.55 a.m.

WOMEN'S ENGINEERING SOCIETY.—Visit to Ross, Limited, Optical Works, Clapham Common, S.W. 4. 10.30 a.m.

TUESDAY, MAY 30TH, TO FRIDAY, JUNE 2ND.

INSTITUTION OF ELECTRICAL ENGINEERS.—Summer Meeting in Scotland. Ladies invited. For programme, see page 326.

WEDNESDAY, MAY 31ST.

ROYAL AERONAUTICAL SOCIETY.—Visit to the Royal Aircraft Establishment, South Farnborough. Meet at Booking Office, Waterloo Station. 8.40 a.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. "The Problem of Provincial Galleries and Art Museums, with special reference to Manchester," by Mr. Lawrence Haward, M.A. 3 p.m.

THURSDAY, JUNE 1ST.

JUNIOR INSTITUTION OF ENGINEERS.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. Fourth Quadrennial Gustave Canet Lecture, entitled "The Railway Act, 1921," by Right Hon. Sir Eric Geddes. 7.30 p.m.

FRIDAY, JUNE 2ND.

DIESEL ENGINE USERS' ASSOCIATION.—Institution of Electrical Engineers, Victoria Embankment. Paper, "Marine Diesel Engines," by Mr. H. F. P. Purday, B.Sc. Non-members desirous of attending the meeting can make application for tickets of admission to the hon. secretary at 19, Cadogan-gardens, S.W. 3.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Discourse, "Gilbert and Sullivan," by the Hon. Maurice Baring. 9 p.m.

SATURDAY, JUNE 3RD.

ROYAL AERONAUTICAL SOCIETY.—Visit to the National Physical Laboratory, Teddington. Meet at the booking-office, Waterloo (L. and S.W.). 9.15 a.m.

MONDAY AND TUESDAY, JUNE 5TH AND 6TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Meeting of the South African District, to be held at Bloemfontein.

THURSDAY, JUNE 8TH.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.—9 Conduit-street, W. 1. Lecture, "What is Architectural Design?" by Mr. D. S. Maccoll, M.A. 5 p.m.

MONDAY, JUNE 12TH.

THE SOCIETY OF ENGINEERS.—Geological Society, Burlington House, Piccadilly, W. 1. Two papers on "The Physical Properties of Clay," by Dr. H. Chatley, D.Sc., and Mr. A. S. E. Ackermann, B.Sc. 5.30 p.m.

TUESDAY, JUNE 13TH.

IRON AND STEEL INSTITUTE.—Mappin Hall, Sheffield University. Adjourned meeting at Sheffield. Continued discussion on "British Siemens Furnace Practice," by Mr. Fred Clements. 3 p.m.

THURSDAY, JUNE 15TH.

ROYAL AERONAUTICAL SOCIETY.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Annual Wilbur Wright lecture. Paper, "Some Aspects of Aeronautical Research," by Lieut.-Colonel A. Ogilvie. 5.30 p.m.

MONDAY TO WEDNESDAY, JUNE 19TH TO 21ST.

INSTITUTE OF COST AND WORKS ACCOUNTANTS.—Sessional examinations will be held in London, Manchester, Birmingham, Sheffield, Glasgow and Bristol.

THURSDAY, JUNE 29TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—Natural History Museum, S.W. Annual conversazione. 8.30 to 11 p.m.

WEDNESDAY TO SATURDAY, JUNE 21ST TO 24TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Annual general meeting and conference at Cardiff. For programme see page 570.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—The result of the ballot for the election of officers and new members of Council for 1922–23 is as follows:—President, Mr. F. Gill; vice-presidents, Dr. W. H. Eccles, F.R.S., and Mr. A. A. Campbell Swinton, F.R.S.; honorary treasurer, Sir James Devonshire, K.B.E.; ordinary members of Council, Mr. J. W. Beauchamp, Mr. R. A. Chattock, Mr. F. W. Crawter, Mr. D. N. Dunlop, Major K. Edgcumbe, Mr. A. F. Harmer, and Mr. W. R. Rawlings.

MAY.

The Engineering Dispute.

THE principal event of the month in connection with this long drawn out dispute was the sitting of Sir William Mackenzie's Court of Inquiry and the publication of his report. The Court closed in a rather threatening atmosphere on Saturday, the 6th, and on the following Wednesday the report was issued. Sir William made no positive recommendation. The matter was one, he said, in which no agreement, however carefully devised, could take the place of good sense and good will between the parties. The trouble arose from the men's fear of displacement, and the report suggested that it should be possible, by joint action between the employers and the unions, to accommodate "in skilled employment the men set free." An outcome of the Court was the issue of an invitation by the Employers' Federation to all the unions to meet it in conference once more. All accepted, including the Amalgamated Engineering Union, and on the 16th of the month a meeting was held at Broadway House. But it had hardly opened when a difficulty arose in the Labour camp, and a few days later the A.E.U. broke away from the negotiations. However, some good work was done, for on Saturday, the 20th, a provisional agreement was reached, and on the following Tuesday the Executive Councils of the forty-seven unions decided to submit the terms to ballot. No recommendation was made on the ballot papers, but it is understood that the returns are to be "massed." The Amalgamated Engineering Union was, of course, out of this arrangement, and after another abortive effort to get its way with the employers, it remained out, but it is clear from speeches made by Mr. Brownlie and Mr. Hutchinson on Sunday that its funds are exhausted, and that it will in the end accept the terms put before the conference. Thus the month came to an end with a strong hope that the useless struggle was nearly over, and that now that the shipyard dispute was settled—it ended on the 8th of the month—better times were ahead in the engineering and allied industries.

The Loss of the P. and O. Liner Egypt.

IT is with deep regret that we chronicle the loss of the Peninsular and Oriental Company's liner Egypt, which was sunk on Saturday evening, the 20th instant, after colliding with the French steamer Seine some 28 miles from the Armen Lighthouse off the Finistère coast. Already before sunset a dense fog was reported on both the English and French coast and generally throughout the Channel. From the information now available, we learn that the Egypt had stopped her engines and was stationary when she was struck by the Seine amidships on the port side between her funnels. Both vessels were at the time sounding their sirens, and the French ship is reported to have been moving at a speed of about 5 knots. Although the Seine has a tonnage of scarcely one-sixth that of the Egypt, she is furnished with ice-breaker bows, and the damage she inflicted was so severe that the Egypt sank in twenty minutes from the moment of impact. Wireless signals were sent out to the last by the wireless operator, who went down with his ship, but the work of rescue was much impeded by the thick fog which at the time prevailed. The Seine, although seriously damaged herself, was able to stand by, and after taking on board the survivors, was able to make for Brest, which she reached safely. The Egypt was one of the oldest boats of the P. and O. line, being a single-screw ship of 7941 tons gross, built and engined by Caird and Co., of Greenock, in 1897. The Seine has a gross tonnage of 1383 tons and is a Newcastle boat built in 1899. This accident again serves to remind us that there are dangers in sea navigation which from time to time assert themselves in defiance of our efforts to surmount them. During the war a great deal of experience was obtained with the submarine sounding gear, and the directional telephone, and this device is now fitted to some of our larger liners with a view to making navigation in fogs more secure. We learn that the Board of Trade will institute a formal public investigation of the accident, which will cover all the material points with regard to the loss of the vessel and the loss of life.

The Institute of Transport Congress.

As one went in and out of the sessions at the Congress of the Institute of Transport held in London between the 17th and 20th, and particularly when present at the well-arranged dinner on the evening of the 18th, it was natural to marvel that the Institution was in only its third year. It had its origin, undoubtedly, in the discussions that led up to the establishment of the Ministry of Transport. That was in the summer of 1919, but it was not until the November of that year that definite steps were taken to found the Institution, and not until March 22nd, 1920, was it formally inaugurated. Now it has 1200 members. The secret of its success is mainly to be found in two factors—the many varied interests covered by the term "transport," and the welcome that is afforded to all those who can satisfactorily claim admission. It speaks well, too, that such busy men, as were all the authors of the papers read at the Congress, were willing to sacrifice their time to write them, to attend their reading, and to enter with such enthusiasm into the subsequent discussions. The standing of the men who spoke in those discussions was also eloquent testimony to the value of the Congress, whilst another feature was that men like Mr. Arthur Watson, Sir Sam Fay, and Sir Joseph Broodbank were always in evidence, showing an interest in the discussions or in the numerous instructive and enjoyable visits. The Congress was not only a success, but a happy augury for the year shortly to commence under the presidency of Sir Sam Fay.

Rhine Hydraulic Power.

THE carrying out of preliminary arrangements during the past month for the constitution of the Compagnie Nationale du Rhin suggests that the difficulties which the French Government has encountered over its scheme for utilising the Rhine for the production of electrical energy are being overcome. The original scheme provided for the construction of a huge barrage at Huningen and the cutting of a lateral canal, 116 kiloms. long, between Basle and Strasburg for the passage of boats of 1200 tons. There were to be eight falls, providing a total energy of 800,000 to 1,000,000 horse-power. The Swiss and other authorities became alarmed at the abstraction of so huge a volume of water from the Rhine, which they feared would be no longer navigable, and suggested that the deepening of the Rhine, where necessary, would permit of the navigation of the bigger boats and obviate the construction of a canal. The French Government, however, adhered to its rights under the Versailles Treaty to divert the amount of water required for irrigation and for power purposes, and a modified scheme, whereby the barrage is to be displaced so as to reduce the current in the canal from 1.20 m. to 0.70 m., is likely to be approved of by the Central Commission. The French hope to be able to prove later on that a velocity of 1.20 m. per second will not interfere with navigation on the river. The idea of the Government is eventually to amalgamate the national companies of the Rhine and the Rhone, which will thus control about 2,000,000 horse-power. It is intended to unify the current for distribution not only over the vast district to be supplied by these two rivers, but also over other parts of the country to be served by the Dordogne, the Alps and the Pyrenees. The whole question of hydro-electric distribution, which has become one of the most important economic factors in France, will be discussed at the electrical congress to be held in Bordeaux during the present month.

The Grampian Hydro-electric Scheme.

THE Bill for sanctioning the Grampian hydro-electric scheme passed through the House of Commons during the month. The proposals, to carry out which, powers are being sought, are of a highly interesting character. The undertaking pivots round Loch Ericht, the water level of which it is proposed to raise by means of two dams, one at either end. By this means, and by making a cut at the outlet end, so that, if necessary, the water can be drawn down to considerably below its existing level, a huge volume of water—not less than 80,000,000,000 million gallons—will be made available. It is further intended, by various diversions, artificially to increase the gathering ground draining to the loch from 52.6 square miles to over 185 square miles. From Loch Ericht the water will be led through a power-house, which, when the scheme is fully developed, will be capable of developing, under a head of 450ft., 26,900 horse-power continuously, the discharge being into Loch Rannoch, from which issues the river Tummel. Lower down the latter there is to be a reservoir which will impound sufficient water to develop, in another power-house with 150ft. head, 17,400 horse-power continuously. There are to be two other power-houses, driven by water obtained from within a neighbouring watershed, which will be capable of developing 4200 and 7500 horse-power continuously, under heads of 650ft. and 870ft. respectively. The total continuous horse-power which it is anticipated will be made available will therefore be 56,000. We have so recently given details of the whole undertaking that it is not necessary to describe it at greater length at the present time.

The Majestic and the Mauretania.

DURING the month we described the new White Star liner Majestic, and gave some particulars of her machinery. Additional interest now attaches to this vessel on account of the fine performance she made on the homeward run of her maiden voyage, which ended on her arrival at Southampton on Saturday last. Her speed average over five hours on one day was 27 knots, and throughout the whole of a day she made an average speed of 23.59 knots. It is true that these results, good as they are, do not surpass the performance of the Cunarder the Mauretania, which, on her recent record run, made an average speed across of 26 knots and maintained 27.04 knots during one day; but they do show that the Majestic is capable of splendid steaming. We believe that in designing and in building the largest ship in the world it was the intention of her original builders and owners to make her unique not only in size but also in speed, with a view to regaining for Germany the Blue Riband of the Atlantic, which had been won by the Cunard liners Lusitania and Mauretania. For the Majestic's large displacement of 64,000 tons, her normal turbine rating of 66,000 shaft horse-power is on the conservative side, perhaps, and it would certainly appear from the maiden voyage and the voyage from Cuxhaven to Southampton that, without pressing, her machinery is capable of a larger output. As yet the Majestic is a new ship, but there is little doubt that when her engineers are fully conversant with the capabilities of her boilers and turbine plant, the present excellent performance will certainly be improved upon.

New Sewage Pumps at Richmond.

ALTHOUGH they had actually been in operation for some time previously, the formal putting into service of some new pumps at the sewage works of the Richmond Main Sewerage Board took place during the month. These works are interesting by reason of the diversity of pumping machinery which they contain. There are, first of all, three double-ram force pumps, which are driven by cross-compound horizontal steam engines, and though they have now been at work for many years—thirty-one, as a matter of fact—they are still remarkably efficient machines. Each can deal with four million gallons in the twenty-four hours. Then there is a vertical Worthington pump, which can cope with fourteen or fifteen million gallons per day. Next, there are two gas engine-driven centrifugals, which can each raise ten million gallons in the day, the head in all cases being about 40ft. The latest additions are also centrifugal pumps, but, unlike those just mentioned, they are electrically driven, the object in installing them being so that they may be used in times of light load—such as during the night—when it is undesirable to have the boilers under steam. Each of the new pumps is designed to lift sewage at rates of from 3,000,000 to 5,000,000 gallons per day, the amount depending upon the depth of sewage in the well. The pumps, which are of the vertical spindle type, are driven by vertical spindle direct-current motors which operate at 500 volts, the speed being variable between 520 and 650 revolutions per minute. There are two flexible couplings between motor and pump, so that none of the weight of the vertical connecting shaft is borne by either machine. The electrical energy is obtained from an outside source, so that, as in the case of the gas-driven pumps, it is not necessary to keep a large staff standing by when there is comparatively little sewage to be pumped.

French Fairs.

THE popularity of commercial and industrial fairs in France may be gathered by the increasing number being held all over the country. The Paris Fair held during the month was one of the largest so far as the number of exhibitors was concerned, and on account of its situation it attracted many visitors. Being devoted exclusively to French products it was particularly interesting as showing the progress that has been made in many of the national industries. So great has been the industrial development during the past four years that French manufacturers are now able to supply nearly everything required by home consumers. It is observable that certain British and other foreign firms are more and more inclined to manufacture in France, instead of endeavouring to compete for trade against the unfavourable exchange rate and the high import duties. The head of one well-known English firm, in opening a branch in France, stated that he had been obliged to manu-

facture his products in that country on account of the exactions of British workmen, who made it almost impossible to export goods to the Continent. Still, the French fairs show that there are many classes of manufactures in which British firms can do business in France, for superiority of design and manufacture in the case of special machines are sometimes of more importance than price, and it must not be overlooked that even French makers are complaining of high productive costs, caused by the raw material and transport charges, and if it were not for the import duties there would be little difficulty in the way of selling British machinery on the French market. For that reason, the international fairs, such as those held at Lyons and Bordeaux, offer opportunities to British firms for bringing their machines to the notice of continental buyers, while fairs of agricultural machinery are now being held all over the country. There is scarcely an agricultural centre which does not have its "week's fair," but they are rarely held at a time most favourable for doing business. They nevertheless serve as an introduction to buyers who may be induced to purchase at the opportune moment.

The Flood Problem in China.

By H. T. WRIGHT, A.M. Inst. C.E., A.M.I. Mech. E.

CHINA, and particularly that part of it known as the great plain which extends northwards from the Yangtze to Tientsin in the north-east, an area which includes the provinces of Hupeh, Anhwei, Honan, Shantung, Chihli, and in a lesser degree Shansi, is a land of alternating droughts and floods. Four years ago the floods in Chihli were the worst experienced in a period of some 150 years, and at least 5½ millions of people were involved in this calamity. Tientsin, situated as it is near the junction of the Grand Canal with several of the most important rivers in this area, was seriously affected and the roads in the foreign settlements were under water.

In 1920 the five northern provinces suffered severely through drought, and this was followed last year by unusually heavy rains which have resulted in famine conditions over large areas, principally in North Kiangsu, Anhwei, and the southern part of Shantung. The following figures show approximately the number of famine victims in the affected provinces:—Anhwei, 3,000,000; Kiangsu, 3,000,000; Shantung, 2,800,000; Honan, 1,500,000; Hupei, 1,500,000. Famine conditions have been reported from various districts in other provinces, and the total number more or less on the verge of starvation cannot be less than 15,000,000.

Combine these successive lean years with the devastation and general topsy-turvydom caused by civil war and internecine strife, to which there seems to be no end, and which is the direct result of the sordid desires of Super-Tuchuns and militarists for the spoils of office, and it will readily be conceded that China's cup of sorrow is filled to the brim. Nor does there seem to be any hope of improvement for many years to come. It is true that the Chihli River Commission has done and is continuing to do good work, but so far as the writer can ascertain the results obtained up to the present are largely the recorded observations of rainfall, stream velocity, silt content, &c., and as systematic observations and gauging of the rivers only began in 1918, it is perfectly obvious that, given the necessary funds, which certainly will never be made available under the existing *régime*, some years must elapse before serious flood preventive measures can be undertaken.

Fig. 1 shows the drainage system of the rivers in North China, and a consideration of the flood producing factors will make it clear that the conditions are almost unique.

Practically the whole of the rainfall in this large area takes place in July and August, and then with tropical intensity. The following figures give the rainfall at Shih Chia Chuang, the junction of the Peking-Hankow and Cheng-Tai railways, in the year 1917:—June, 29mm.; July, 459 mm.; August, 270 mm.; September, 226 mm.; October, 59 mm.; Total, 4043 mm. The maximum fall for any one day occurred on the 26th July and amounted to 260 mm., or approximately 25 per cent. of the total for the year. As that was the tenth day of an almost continuous downpour, it is not surprising that the volume of water sweeping over the Chihli plain caused tremendous damage and was the cause of the floods in and around Tientsin, to which reference has already been made. Although rainfall records are not generally available, the occurrence of floods in other parts of the country

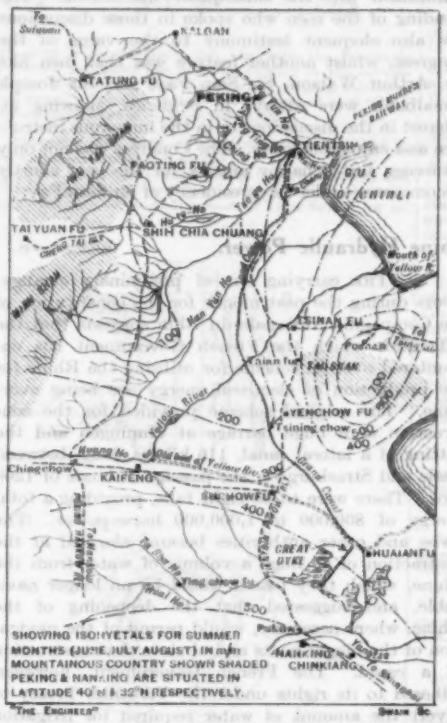


FIG. 1—THE DRAINAGE SYSTEM OF RIVERS IN N. CHINA

negatives the view that the Shih Chia Chuang downpour was local in character and confined more or less to the area immediately adjacent to the Peking-Hankow Railway in the northern section.

No very reliable rainfall determinations are yet available for the whole of north China, but additional gauges are now being installed as and when they can be obtained by the Hydrometric Survey Department. In this connection it is to be noted that arrangements have been made with the China Inland Mission for gauges to be supplied by the department to various stations, the records to be kept by the missionaries and forwarded to the department twice a month. Some ten to fifteen gauges have already been installed including those at Tatungfu, Kalgan, Sinchow, Taiyuanfu and Wei-whei-fu, and it is understood that the arrangement is working well.

Isohyetals of summer rainfall (June, July, August), are shown in Fig. 1, but in view of what has been said concerning observations, these curves should be accepted with some reservation, particularly so in the case of those shown in the Shantung area, where gauge stations are few and far between.

FORESTRY.

Turning now to the forestry aspect of the problem, it can be said without fear of contradiction that conditions could not be worse than they are at the present time.

One of the outstanding features of the hill ranges which border the great North Plain is the bleak and barren character of the denuded crests rising to a maximum of from 3000ft. to 4000ft. above sea level, which increases to 8000ft. in the Wu Tai Shan area. Fig. 2, which was taken at the latter place, and Fig. 3 showing the extreme edge of the hill ranges west of Shih Chia Chuang, are typical views of this hilly country which forms the catchment area for the whole of the rivers in that part of China now under consideration, and this area presents the two unfavourable factors of bare surfaces and steep slopes in a marked degree. The hills are practically treeless, the only trees to be seen being pines and firs in or near temples and round ancestral graveyards. It is generally conceded that the effect of a covering of vegetation on watersheds in flat countries is unimportant except in so far as it retards the discharge and more or less equalises the flow, but in China this protective influence has been eliminated and the result is a high rate of "run-off." As a sole means of modifying the "run-off" reforestation is useless, but the loss through evaporation and interception by the foliage, and by transpiration, is not to be ignored, apart altogether from the general equalising effect and time lag imposed. Although of no immediate advantage, therefore, reforestation should be given a prominent place in any improvement scheme. At the moment little or nothing is being done to counteract the deterioration brought about by the interference of man except in Shansi, where Tuchun Yen, whose headquarters are at Taiyuanfu, has made tree planting compulsory.

The general characteristics of discharge for all rivers north of the Yangtze, viz., a freshet and a normal period extending over the larger part of the year, are shown in Fig. 4, which gives the discharge of the Yung Ting Ho at Lu Kou Ch'iao. The ratio of the rising to the falling rate varies from 4¼ in the case of the Yellow River to 11 for the Ta Ching Ho at Wei Ho. Particulars of rate of run-off to rainfall are now available* for a period of about seven years only, but apart from lack of observations extending over long periods, the writer considers that the depletion and make up of underground storage, and the abnormal time lag consequent on the peculiar conditions obtaining in this area, which are discussed below in more detail, make it extremely difficult, if not impossible, to do more than utilise the particulars along general lines. This conclusion is substantiated by the figures available for the Ta Ching Ho which show a run-off as percentage of rainfall of only 1.5 to 2.5 for July, and 33.0 for early October. It should be noted, however, that although the percentage run-off is small for the month of July, the actual amount is large owing to the fact that this period comes within the rainy season. The effect of thawing on the total discharge in late January and February is small, owing to the fact that the snow evaporates and very little finds its way underground.

GEOLOGICAL CHARACTERISTICS.

Practically the whole of the great plain extending from the hill ranges to the sea consists of loess and or alluvium with varying amounts of gravel and sand. A discussion as to the conditions of formation is not within the scope of this article,† and it is sufficient to state that in the loess basins from Wu Tai Shan in North Shansi to south of Taiyuanfu and Shih Chia Chuang areas, the distribution is largely due to muddy waters and that the deposits contain notable amounts of gravel and sand. The general covering of loess alluvium over the Chihli plain is undoubtedly due to the Yellow River which discharged *viâ* the Wei Ho and Tzu-Ya Ho during the twelfth century. That found spreading upwards from the plain on to the concave surfaces of the hills is wind assorted and may have a thickness of as much as 1000ft. Fig. 6 is a hypothetical section showing the general mantle of

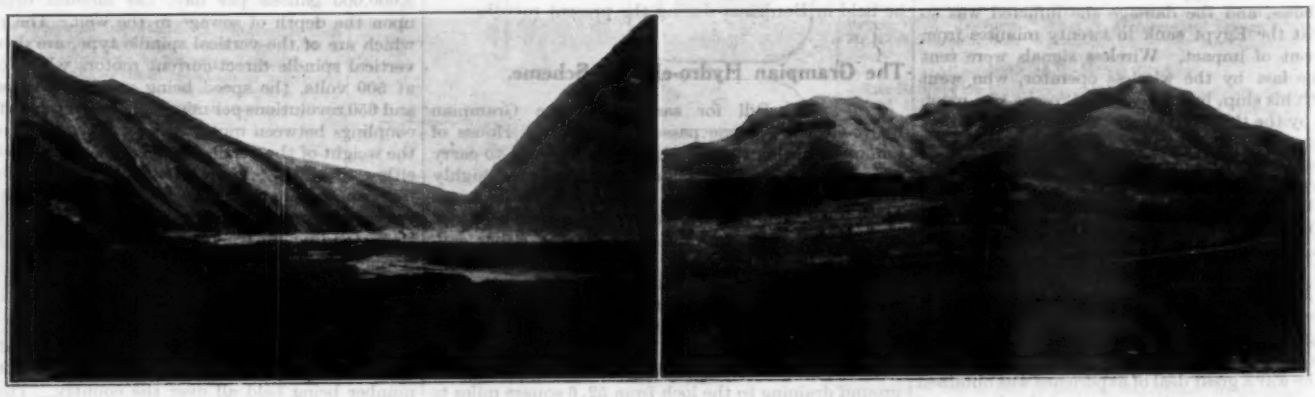


FIG. 2—VIEW IN THE WU TAI SHAN AREA

FIG. 3—HILL RANGES WEST OF SHIH CHIA CHUANG

* Annual report on Hydrometric Survey issued by the Commission for the Improvement of the River System in Chihli.

† "Researches in China," Vol. 1, Part 1, Bailey-Willis. Carnegie Institute of Washington. "China," by Von Richthofen. "Relations of Secular Rock Disintegration to Loess," by Pumpelly. Smithsonian contributions, Vol. XV.

loess and terrace cultivation, surmounted by wind scoured crests. The underlying rocks are largely plutonic and metamorphic, and they give the hills a rugged and barren appearance. The characteristics of the loess are firmness in mass which permits it to stand in almost vertical walls, fineness of the individual particles, and generally a peculiar texture showing a

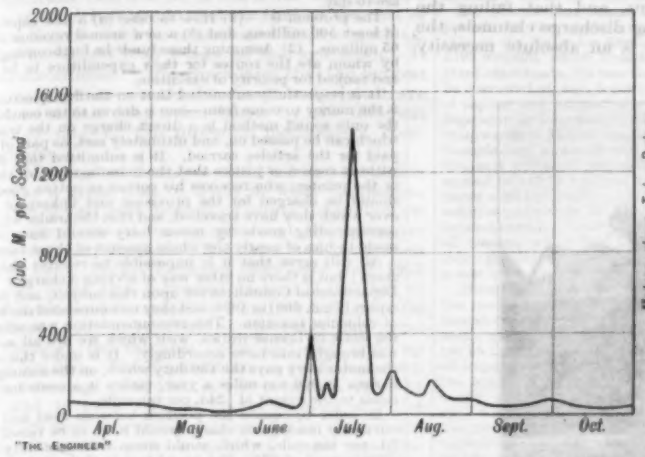


FIG. 4—CURVE SHOWING DISCHARGE OF THE YUNG TING HO AT LU KOU CH'IAO

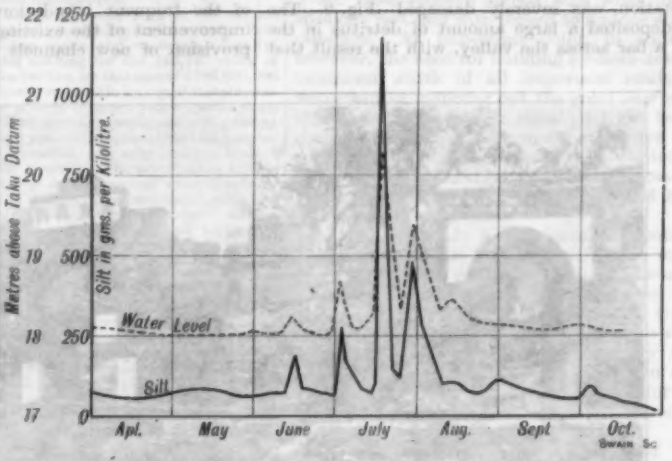


FIG. 5—CURVES SHOWING WATER LEVEL AND SILT CONTENT OF THE WEN YA HO AT TUNGCHOW

more or less vertical arrangement of tubes which gives it an enormous capacity for storing water. Unfortunately this characteristic is a decided disadvantage when the loess rests on an inclined surface, owing to the fact first pointed out by Slitcher, that solid particles with diameters less than the thickness of a capillary film of water may enter the film and

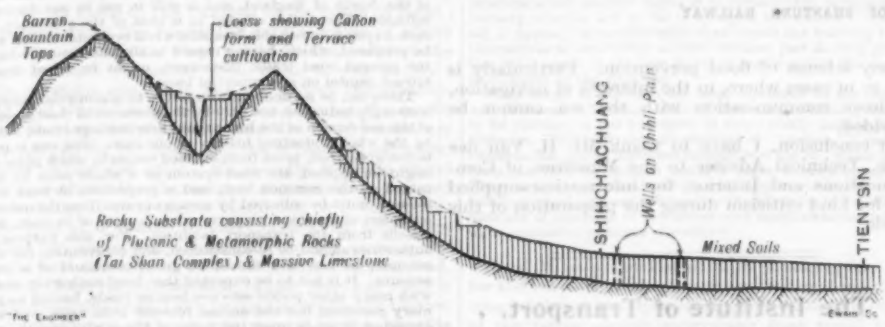

Barren Mountain Tops
Loess showing Cañon form and Terrace cultivation
Rocky Substrata consisting chiefly of Plutonic & Metamorphic Rocks (Tai Shan Complex) & Massive Limestone
SHIHCHIACHUANG
Wells on Chihli Plain
TIENTSIN
Mixed Soils
"THE ENGINEER"
SWAIN Sc

FIG. 6—HYPOTHETICAL SECTION SHOWING MANTLE OF LOESS AND TERRACE CULTIVATION

flow with the liquid. Hence the very large quantities of mud and silt brought down by rivers which derive their waters from the loess areas. The sudden down rush of storm water cuts right through the loess down to the base gravels producing a miniature cañon form. The vigorous up-stream growth of these cañons, evidenced by the frequent changes made in the roads which traverse the foot hills, points to rapid erosion, and although only main streams are to be seen crossing valleys and alluvial plains, the silt is brought down in large quantities and introduces the main difficulty which confronts the conservancy engineer. A comparison of the water-level and silt content curves for the Wen Ya Ho at Tungchow is shown in Fig. 5. For normal water-level the silt content is practically constant, but during the freshets it increased enormously, as is to be expected from the v^6 law.

RIVERS AND FLOODS.

The problem is further complicated by the fact that all the rivers have steep gradients in their upper reaches and gentle gradients in their lower courses. As the latter are in an alluvium plain, the unequal erosion of banks and consequent shifting of channels may give an exaggerated idea of the amount of silt brought down from the catchment areas. For a fairly correct determination of the latter, therefore, silt determinations should be carried out above the alluvial reaches. As regards the Yellow River, no better example of the effect of silt on the migratory action of rivers could be given. This great river, which rises in Kokonor, borders the Shansi province in a general direction from north to south, and then from west to east, and is therefore the main drainage channel for the large loess areas in Shensi and west of the main hill ranges in Shansi. As the river raises its bed by the deposition of silt, the people endeavour to restrain the overflow by raising the dykes until an unusually heavy flood breaks through these artificial barriers and a new channel is formed. Historical records show that this has occurred at least eight times in the past 2000 years, and the river has discharged into the sea at points nearly 400 miles apart. During the period 1060 to 1194 A.D. it discharged into the Yellow Sea near Tientsin. A break then occurred in Shantung, and was followed in 1289 by a break at Kai Feng, which let the waters into the bed of the Huai River. Forty years later it again changed its course, entering the bed of the Huai River at Tsing Kiang Pu. In 1852 the last and one of the greatest of the breaks occurred at Kai Feng, the river finding its way to the sea north of the Shantung promontory in a north-easterly direction, passing Tsinanfu and leaving its old bed in the form of a great ridge above the surrounding country.

Although at the present time the Huai and Yellow Rivers are at least 150 miles apart, the latter is largely, if not entirely, responsible for the floods on the former in North Kiangsu and North-West Anhwei. Thousands of square miles of farm lands have been inundated, with consequent great loss of life and damage to houses and crops. It was in this area, extending from the Huai River to Tsiningchow, that the embankments of the Tientsin-Pukow Railway were washed away, resulting in a break of several weeks in the through communications between Tientsin and Shanghai. As previously stated, the Yellow River began to silt up the bed of the Huai River from Tsing Kiang Pu to the sea in 1329. The gradual elevation of the bed forced part of the waters of the Huai into the Grand Canal—see map, Fig. 1—but as the silting-up process continued and more of the Huai waters were forced to the south, the river started to find an outlet for itself to the Yangtze. Serious flooding occurred, and during the reign of one of the Ming Emperors the great dyke was built connecting the slightly elevated land west of the Grand Canal with the southern bank at the junction of the rivers. This structure, over 35 miles long and 30ft. in height, with an average width of 100ft., was stone-faced, and was intended to protect the low-lying lands to the east and south. As the silting-up process continued, however, the canal was inadequate to deal with the whole of the waters of the Huai, and the Hungtze Lake was formed. Eventually a heavy flood destroyed part of the dyke, allowing the waters to find their way to the Yangtze. After this the right bank of the canal was raised and fitted with numerous sluice gates with the idea of protecting the land to the east of this area. In normal times the outlet to the Yangtze is adequate, but last year the latter river was in flood, making it correspondingly difficult for the Huai to discharge its waters, and it was found necessary to open some of the sluices in the east bank of the canal. A wall constructed some hundreds of years ago to prevent the inrush of tidal waters makes it difficult to drain this area, which has been converted into a shallow lake of large dimensions.

FLOOD DAMAGE.

Figs. 7, 8 and 9, together with the series of views in our Supplement, give some idea of the havoc caused by the unusually heavy rains of last summer in the Po Shan area, Shantung. Po Shan, the terminus of the branch line from Chang Tien on the Shantung Railway, is one of the centres of the coal-mining industry in this area, and largely in Japanese hands. The rainfall for July was from 12in. to 14in., and in August a series of heavy storms brought the total for the two months up to 30in. approximately. The tremendous run-off restricted to a comparatively narrow valley—Fig. 7 and Fig. 11 in the Supplement

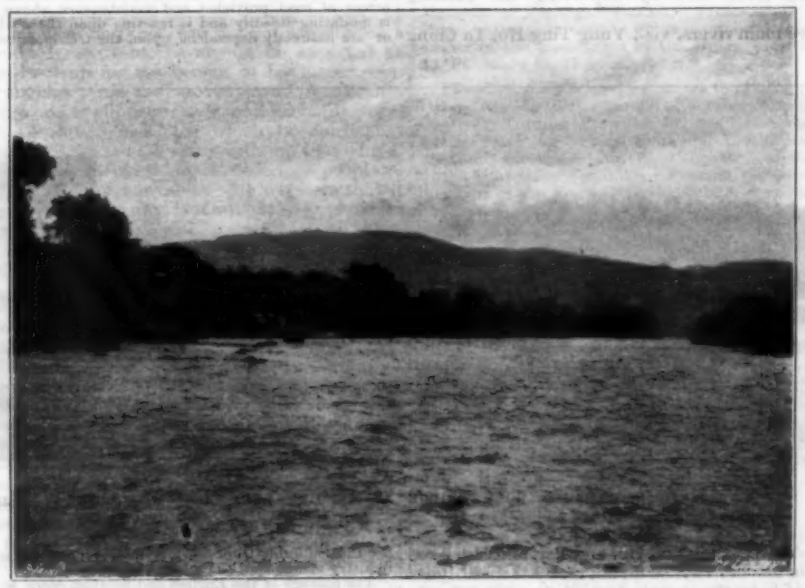


FIG. 7—FLOOD IN THE PO SHAN AREA, SHANTUNG

—swept this clear of obstructions. Fig. 13 shows the two ends of a house, the centre of which, together with its Japanese inmates, was swept away. Fig. 14 shows this same house taken from the near bank shortly after the catastrophe. The remains of the

65 lb. track which crossed the valley at this point are shown in Fig. 8 and in Figs. 15 and 16 in the Supplement. Figs. 17 and 18 in the Supplement are interesting, in that they show houses on the point of collapse.

At Ta Kun Lun, the next station to Po Shan on the branch line, a road bridge, built by the owners of several small coal mines situated about 8 miles east of the station, was severely damaged—Fig. 9. The waters deposited a large amount of detritus in the form of a bar across the valley, with the result that

FIG. 8—DESTRUCTION OF BRANCH OF SHANTUNG RAILWAY

the river changed its course by about half a mile, leaving the remains of the bridge high and dry—Fig. 10.

Flood Prevention.

From the foregoing remarks it will be clear that the flood-producing factors cannot be wholly removed, and that only one or two can be modified to any considerable extent. Climate, gradients, surface conditions in the catchment area, and shortage of natural storage have to be taken for what they are, although it might be possible to compensate for the latter by artificial works were it not for the silt problem. Apart from topographic considerations, these conditions render an effective reservoir system impossible as the removal of the soil would be an expensive item, with the added difficulty as to where the excavated matter was to be deposited. Moreover, large areas would have to be put permanently out of cultivation in order to cope with floods which occur infrequently and at irregular intervals. With the exception of re-forestation, therefore, the only practical solution lies in increasing the gradients in the lower reaches by cut-offs, giving the river a greater cross-sectional area by building dykes, thus raising the water level, and by improving the existing outlets.

The five main rivers, viz., Yung Ting Ho, Ta Ching Ho, Tzu Ya Ho, Nan Yun Ho, and Pei Yun Ho, have all more or less been dyked in, but many of these dykes are able to keep the river in bounds during moderate freshets only, and much remains to be done. In the case of the last-named river, it is to be noted that the dykes are wide apart—a necessary condition (1) in order to ensure a longer duration of high water for the sake of navigation, and (2) because the river has to pass through a densely populated district (Tientsin city).

The various river systems have several outlets each, but in all cases the capacity of these outlets is far below the maximum run-off, from which it follows that when a sudden influx of water exhausts the storage capacity of the river bed, floods inevitably occur. These floods necessarily raise the flood plain and cause an increase in the rate at which silt is deposited. It is the studied opinion of those best qualified to speak on such matters that the insufficiency of the outlets constitutes the principal cause of the frequent inundations, and that failing the improvement of the existing discharge channels, the provision of new channels is an absolute necessity in any scheme of flood prevention. Particularly is this so in cases where, in the interests of navigation, a direct communication with the sea cannot be provided.

In conclusion, I have to thank Mr. H. Van der Veen, Technical Adviser to the Ministries of Communications and Interior, for information supplied and for kind criticism during the preparation of this article.

FIG. 9—DAMAGED ROAD BRIDGE AT TA KUN LUN

FIG. 10—BRIDGE LEFT DRY AS RESULT OF CHANGED COURSE OF RIVER

The Institute of Transport.

No. III.*

On Friday, May 19th, Mr. Dixon H. Davies presented a paper entitled "The Finance of the Modern Highway: A Problem and a Solution." We give some extracts from it below.

THE FINANCE OF THE MODERN HIGHWAY.

The call upon the rates for roads has reached the dimensions of a grievous burden, and it seems to be generally admitted that no increased revenue for the purpose can be looked for from that source. The natural result, therefore, is that the arrear of road provision and maintenance above spoken of, is mounting steadily and is reacting upon those who conduct, or are indirectly dependent upon, the transport trades, which are thus suffering from the inevitable evils attendant upon an industry insufficiently supplied with capital.

The mileage of the English and Scottish roads is 177,306, of which 36,589 miles are already listed as classified roads.

The cost of reconstructing a road for motor traffic is difficult to state as a general statistic, varying, as it does, from £5000 to £100,000 a mile according to the local circumstances and the weight of the traffic passing. It is difficult, however, to see how any satisfactory scheme for equipping the country with motor roads could be carried through for a less capital expenditure than 500 millions sterling. The annual cost of this on a 5 per cent. basis, with a provision for renewal every ten years, would be about 65 millions per annum, and this would be required in addition to the revenue from rates which would be no more than sufficient for the ordinary maintenance and the costs of the other unclassified roads.

Serious as these figures are, it is probable that they are well within the mark. It is hardly to be expected, reckoning with the modern cost of such works, that the country can be equipped with a complete system of arterial communications adapted for fast-moving and heavy mechanical traffic for much less than two-fifths of the cost of the railway system, constructed as that was when wages and prices were very much lower than they are to-day.

The problem is:—(1) How to raise (a) a new capital sum of at least 500 millions, and (b) a new annual revenue of at least 65 millions. (2) Assuming these funds be forthcoming, how and by whom are the routes for their expenditure to be selected, and ranked for priority of execution.

It is respectfully submitted that on the first question—where is the money to come from—one is driven to the conclusion that the only sound method is a direct charge on the traffic itself, which can be passed on, and ultimately met, as part of the price paid for the articles carried. It is submitted that it is quite without reason or justice that the manufacturer, or the packer, or the printer, who receives his cotton or cotton goods by rail should be charged for the provision and upkeep of the road over which they have travelled, and that the trader who receives corresponding goods by motor lorry should have a present made to him of nearly the whole amount of those costs.

All will agree that it is impossible to re-erect the turnpike gates; but is there no other way of levying a charge? A strong Departmental Committee sat upon this subject, and made their report (Cmd. 660) in 1920, and they recommended the imposition of vehicular taxation. This recommendation was adopted, and the scale of licence duties, with which we are all acquainted, was brought into force accordingly. It is under this scale that the motor lorry pays the £30 duty which, on the assumption that it runs 30,000 ton-miles a year, makes it a contributor to the roads to the extent of .24d. per ton-mile.

In order to equate the position between road and rail, this obviously inadequate charge would have to be raised to about 3d. per ton-mile, which would mean a licence duty of about £360 instead of £30. The broad fact is that, if the business of transport of goods by road is to be adequately provided for, and made to pay its way, it must be laid under charge for road provision and maintenance to the extent of something like 3d. per ton per mile. It is probable that any proposition to this effect would be greeted with a considerable outcry from parties interested in the motor trade. It is, therefore, worth while considering whether there is any alternative other than an equally intolerable increase of the county rates. The invention of such an alternative is obviously more a matter for engineers and highway administrators than for one who has no qualification in either respect, but it may be suggested that such persons might usefully turn their attention to a now nearly abandoned device which was at one time not infrequently met with on the roads of the North of England, and is still in use in our Australian colonies. The device alluded to is that of the plate-way. By such a system in suitable localities a real economic saving would be produced, which, having regard to the enormous tonnage of the present road traffic movement, might be relied upon to attract capital on a commercial basis.

There can be no doubt that a resort to commercial enterprise is strongly indicated, not only by the above-cited close precedent of the conversion of the horse roads into carriage roads, but also by the whole industrial history of our race. But one is bound to recognise that, apart from selected routes to which plate-ways might be applied, the road system as a whole must be maintained at the common cost, and a proportion at least of the revenue must be collected by means of rates from the owners or occupiers of land and property who, in meal or in malt, derive benefit from the transport facilities. For this purpose, the authorities should be re-constituted, and constituted, the writer submits, *ad hoc*, and should be given command of a capital account. It is not to be expected that local authorities charged with many other public services besides roads, having no pecuniary resources but the annual revenue from rates, and whose existence depends upon the votes of those who pay the rates, should be capable of framing a road programme based upon far-seeing policy.

In opening the discussion, Mr. H. H. Gordon demurred to the way in which the problem had been presented, and to the solution suggested. The author of the paper appeared to resemble nothing so much as the eminent surgeon whose operations were always successful, but whose patients invariably died. He was under the impression that if the conclusions of Mr. Davies and his suggestions for motor transport were carried out there would soon be very little motor transport to make provision for. Personally, he objected to the plate-way system, which would make motor transport dependent on large and full loads. In that way motor transport as it existed to-day would be destroyed, and for it a very inferior railway system would be substituted. He suggested that the community should go on in the future as in the past, and be responsible only for the provision of such highways as the ordinary traffic of the district might demand.

Sir William Acworth felt that Mr. Davies was right when he said that the persons who made exceptional use of the roads ought to be charged specifically for it. He did not see why there should not be a sealed-up

* No. II. appeared May 26th.

mileage recorder on the basis of which each individual wagon could pay. In his opinion there were two kinds of users—what might be called local traffic and through traffic. He could not see why the farmer should pay another toll for sending his stuff to market. Farmers and producers to his mind had a prescriptive right to use the roads for ordinary local purposes, but through traffic had not, for it was never contemplated that a truck driver would destroy that to the cost of construction of which he contributed little or nothing, or that he should reap where he had not sown. It was to the interest of the community that the lightest made conveyance should be used, and that there should be a fair proportion borne by the different classes of user of the different methods of communication.

Lord Montagu of Beaulieu said that in his opinion there was a great deal of truth in what the author of the paper had said, but, as a County Councillor, he (the speaker) was of the opinion that the ratepayer was getting very restless. The rates had more than doubled since 1914. Between that date and 1921 the total rates had increased from £71,000,000 to £149,000,000, and the rateable value from £211,000,000 to £233,000,000, so that whilst the rates had more than doubled, the rateable value had only gone up by £12,000,000. The expenditure on roads had risen from an average of 9.42d. in the pound in 1913–14 to 19.99d. in 1919. Those figures showed why the ratepayers were becoming restless. The fact of the matter was that a great number of people used the roads who hardly contributed to the cost at all. He believed that his own local rates came to £1200 a year, and he had to pay just as much if he ran a Rolls-Royce or a Ford as the man who paid nothing towards the local rates and probably lived in a flat in London. He awaited with interest the decision of the Houses of Parliament on the inquiry that was proceeding.

Mr. Rees Jeffreys confessed that he was not such a pessimist as the previous speaker. He was not at all alarmed at the expenditure on the roads, for it was a productive expenditure. Lord Harris had been talking in another place of the burdens of the roads in Kent; but take away the roads, the capital value of which was tens of millions, what would be the value of the land in Kent compared with what it was to-day? The question was, what was the proper contribution the land should bear towards maintaining the roads, and whether at the present time the rural landowner was not paying too much and the urban and suburban owner paying too little. He thought it was a sound principle that if the character of the road were changed by building it to a higher standard, or if the reconstruction of a bridge to carry a heavier type were called for, there was a case laid out for making the traffic find the capital cost. But to go further and, having found the capital cost, to put upon any section of the community and any particular traffic the burden of maintenance without any regard to the benefits to the other sections of the community, was going just a bit too far.

Mr. Alfred Dryland confessed himself an optimist regarding the present position. The country would struggle through if only it had a little patience. No one could expect to reconstruct the roads of the country in five minutes. A start had hardly been made yet, but if a progressive policy were pursued, and if money were spent wisely on forms of construction that would reduce the cost of maintenance, he thought in a very few years roads able to carry the traffic that was likely to come upon them would be seen.

One of the papers taken on the first day of the meeting was contributed by Colonel C. H. Bressey, O.B.E., Roads Department, Ministry of Transport, and dealt with "The Construction of Highways." We present an abstract of it.

HIGHWAY CONSTRUCTION.

In this ancient country, already thick set with tortuous thoroughfares, the road designer is usually faced with perplexing alternatives; on the one hand, to widen, improve and straighten existing roads; on the other hand, to strike out along an entirely new line. Local sentiment will generally favour the former and more timid course, often unwisely. The bolder course presents, however, less difficulty to-day than in former years, and it may be worth while to review its advantages. First and foremost, an alternative route is provided of inestimable value when the original road is under repair or obstructed from any cause; the future development of the town is fostered by the formation of a new thoroughfare which creates fresh rateable value, whereas the widening of the old High-street involves the demolition of existing property and the destruction of rateable value (temporarily at least); in many cases, the surplus lands left after the widening has been effected are too shallow to possess any appreciable value as building sites; the designer of the new road can usually secure an alignment far superior to that obtained by the mere improvement of an existing highway, and he can set out the gradients with a freedom impossible where an old highway is being modified. In the case of a new road across open land, many expensive contingencies are avoided, such as the removal of telegraph poles, the relaying of underground mains, cables, ducts, &c.

No one questions that the roads of the United Kingdom need reconstructing. Finance is the supreme stumbling-block, but the difficulties of the problem are disguised by the habit usually adopted of quoting road surfaces by the yard super, a trifling figure of a few shillings which seem well within everyone's reach. For the purposes of rough calculation, it may be taken that, with a 20ft. width of carriageway, every shilling per yard super represents £600 per mile run (allowing about 2½ per cent. for trifling contingencies); in other words, 1d. per yard super represents £50 per mile run. An economical method of surfacing (clinker asphalt) has been given several years' trial in Hornsey, Sheffield, &c., with favourable results, and the city surveyor of Sheffield has recently quoted its cost at from 9s. to 12s. per yard super, 2in. thick. Selecting this for purposes of illustration, let us assume that, with added experience and falling costs, the price can be reduced to 10s. per yard super. On that hypothesis, and assuming, too, that the road foundations can be relied upon, re-surfacing to this specification would cost £6000 per mile run. The total length of first-class roads on the Ministry of Transport's list is 22,160 miles, which, multiplied by £6000, gives you a total of 133 million pounds. True, a considerable proportion of the total mileage has already been reconstructed, but, against savings in that direction, there is to be taken into account the necessary strengthening of foundations and other auxiliary works on roads still unimproved.

On second-class roads, £4500 per mile run, or 65 million pounds for the whole number, would have to be spent. Add this to the figure for first-class roads, and we reach a total of £198,000,000, which includes nothing for the 140,727 miles of third-class roads. To ease the burden, let this sum of £198,000,000 be borrowed at, say, 5 per cent., repayable by equal instalments of capital and interest over a term of seven years—perhaps an imprudently long period. The annual repayments will amount to upwards of 34 millions, and you will recollect that this general re-surfacing, however well executed, will only enjoy a limited life, and will need periodical renewal. The significance of this annual call of 34 millions will be more apparent when it is compared with last year's yield of the tax on mechanically propelled vehicles—upwards of £10,000,000—or, with the total annual expenditure by local authorities on highways and bridges of all classes, which has been estimated at £50,000,000, though this is possibly an over-statement for to-day, when the purchasing power of the pound is steadily rising.

Materials.—It would be rash to assume that, in spite of all the modifications of twentieth century methods, water-bound macadam has no further utility. In many lightly trafficked areas, good water-bound materials, surface-dressed with refined tar or bitumens, are still found to play an efficient part. The all-important ingredient in the road conglomerate was heretofore the aggregate, i.e., the actual cubes or fragments of granite, basalt, quartzite, slag, &c., of which the road mosaic was built up. What a change has now come over the scene! The chemist has come into his own, the analyst bestows his deepest, most vigilant study upon the qualities of the matrix—the asphaltic or bituminous binder, the pitch or tar, which is to convert the loose materials into an impervious, voidless, dustless sheet, possessing attributes of elasticity and resiliency which blunt the destructive effects and impact of heavy traffic. The widespread introduction of vertical retorts has had the effect of producing a tar possessing qualities differing widely from those to which road engineers had become accustomed in days when horizontal retorts were general, and the "steaming" process yet unknown. The mention of tar brings to mind a vexed question which exercises the minds of agriculturists and horseowners—the so-called "slippery road" problem. I think it may be said that the inconvenience is steadily growing less acute. In some districts relief has been given by embedding stone chippings of considerable size in the tar-dressed surface; approaching the problem from another angle, it is certain that modifications of farriery practice will go far to mitigate the trouble; but, above all, it appears unquestionable that horses are learning to adapt themselves to new forms of road surface, just as they gradually lost their dread of the new forms of traffic which the motor age introduced to the highway.

Wide scope is afforded for local initiative in the search for and the best utilisation of local materials, enabling economies to be effected in the transport of more costly materials from a distance. Thanks to the introduction of "binders," "matrices," cements, &c., many materials incapable of use in "water-bound" form can now be utilised under a more modern specification. There are, it must be admitted, wide opportunities for a general levelling-up of highway efficiency—the adoption in less advanced districts of methods of procedure and administration borrowed from successful pioneers elsewhere.

Lord Montagu of Beaulieu, in thanking the reader for the very interesting range and width of his subject, congratulated him upon having put within the confines of the paper almost everything that could be said from every point of view. It struck him, however, that Colonel Bressey had hardly laid stress enough on the very important financial problem which road-makers had to face. The total expenditure in 1920 in the United Kingdom was something in the neighbourhood of £60,000,000, so that the allowance of £10,000,000 did not go very far. There was no doubt in his mind that the kind of traffic which caused the greatest damage to the roads was the heavy traffic. The light motor car did comparatively little damage, and he had a certain amount of sympathy with the local ratepayer who said he was willing to keep up his road for local purposes, but did not see why, as a local produce merchant, he should be expected to keep the road up for the benefit of his larger competitive shopkeeper in the nearest town. A reference had been made to slippery roads, and for many years he had advocated measures which he considered would mitigate the troubles met with in that direction. An effort should be made to induce people to use a better form of horseshoe. He felt sure that if the frog was not cut away as it was done, practically by every farrier, a number of horses would stand up far better than they did to-day. Turning to the question of third-class roads, its finance, said the speaker, was the most important problem they had to deal with. It was difficult to know what to do with the little District Councils which were not willing to maintain the third-class roads, which constituted nearly three-quarters of the roads of the country, for the heavy and fast traffic. It was necessary to get the people of this country to understand that roads were absolutely a necessary adjunct to national progress and prosperity.

Mr. J. Cracroft Haller, county surveyor of Nottinghamshire, said that whilst he thoroughly agreed that new trunk roads were necessary in cities like London, Manchester, Liverpool, Birmingham and other large centres, he felt inclined himself to think that perhaps more money had been spent on new routes and new roads, not because they were immediately necessary, but because it was one way of finding work for the unemployed. As a road engineer himself, he confessed that he would very much have liked to have seen some of the money spent on improving existing roads, because what was wanted was the longest possible mileage of good and important roads. As far as the slippery roads question was concerned, there was no doubt that the solution of the trouble was for the owners of horses to see that their animals were properly shod. When they realised that mechanically propelled traffic to-day was 90 per cent. of the whole of the traffic on the road, the day had gone by when they were called upon to consider road construction from the horse point of view. As a result of the recently formed committees of county engineers, he hoped soon to see a great reduction in the cost of highway construction.

Mr. Rees Jeffreys agreed with what the previous speakers had said with regard to finance and the road question. An important point, in addition, was, however, the need for building by-laws describing the minimum width of all important roads. It was important in mapping out the great new routes that the landscape gardener should be got to work, so that the roads could be made attractive as well as convenient. In other words, they wanted to apply as far as they could rules of beauty to these new roads by planting trees wherever possible and by opening up vacant spaces.

Lieut.-Colonel J. Nall argued the policy of the alternative road as against the wholly extravagant policy of the old days of widening extensively congested and narrow thoroughfares in some of the provincial towns. He next dealt with the divided carriageway, and said it was appalling to see the new great roads up and down the country with little narrow carriageways of 20ft. or 30ft. on either side of some central plot that might be used for tramways or to lay a main; two little streams of traffic instead of one wide carriageway.

Mr. J. Sutcliffe, borough engineer of Woolwich, expressed a wish to supplement Colonel Bressey's remarks that the question should be considered from the point of view of railway engineers, but he ventured to suggest that they had already passed that mark, and that they were designing something more than a railway in roadmaking; in other words, the road had beaten the railway, which the people avoided to-day because of the development of motor traffic. The mechanical vehicle was the only thing worth considering, and the Ministry of Transport would do well to encourage the collection and circulation of all information on the subject for the benefit of everybody.

INSTITUTION OF NAVAL ARCHITECTS.

SUMMER MEETING.

PROVISIONAL PROGRAMME.

Monday, July 3rd.—9.15 a.m., leave Victoria (*viâ* Folkestone and Boulogne); arrive Paris 4.35 p.m.

Tuesday, July 4th.—10 a.m., opening of the meetings by the President of the Association Technique Maritime, Monsieur Bertin (President of the Académie des Sciences), at the Sorbonne, Rue des Ecoles, Boulevard St. Michel). The chair will subsequently be taken by his Grace the Duke of Northumberland, C.B.E., M.V.O. (President of the Institution of Naval Architects). Papers: (1) "The Tendency of Warship Design as Affected by the War," Sir Eustace T. d'Eyncourt, K.C.B., D.Sc., F.R.S. (Vice-President); and (2) "Influence of the Washington Conference on the Development of Certain Types of War Vessels," Major L. Fea, R.I.N. 5 p.m., reception and tea given by Monsieur and Mlle. Bertin, 8, Rue Garancière (near the Sorbonne).

Wednesday, July 5th.—10 a.m., at the Collège de France, Room No. 3 (adjoining the Sorbonne). Papers: (3) "Stability of Large Ships," Sir John H. Biles, K.C.I.E., LL.D., D.Sc. (Hon. Vice-President); and (4) "New Methods of Testing Materials," Professor L. Guillet, of Paris. Afternoon, visit to works in or near Paris. 7.45 p.m. dinner of the Institution at the Union Inter-Alliée Club, 33, Faubourg St. Honoré.

Thursday, July 6th.—10 a.m., at the Collège de France, Room No. 3. Papers: (5) "Further Experiments on Contrary Turning Propeller Screws," General G. Rota, R.I.N.; and (6) "Proportions and Block Coefficients of Merchant Steamers," Mr. W. J. Lovett. Afternoon, visit to the Chateau of Versailles. Evening, reception given by members of the Ecole Centrale Club, 8, Rue Jean-Goujon.

Friday, July 7th.—All-day trip to Rheims and adjoining battlefields, returning to Paris in time for dinner. Luncheon will be given at Rheims by the Association Technique Maritime.

Saturday, July 8th.—7.45 a.m., leave Paris (St. Lazare Station). 11.1 a.m., arrive Havre. 12 noon, luncheon at the Palais des Regates, given by the Municipal Council of Havre, the Chamber of Commerce and the shipbuilders of Havre. Afternoon, visits to the shipyards of Messrs. A. Normand, Schneider and Co., Forges et Chantiers de la Mediterranée and the Ateliers de la Gironde. 11 p.m., leave by boat for Southampton.

Monday, July 10th.—Visit to the Chantiers Navals Français at Caen.

THE Italian Government is proposing to lay cables connecting Rome with Messina, Catania, and Syracuse, and also between Ravenna and Trieste, and between Genoa and Nice. It is hoped that the work will be completed by the summer. In 1918–19 Italy possessed 3981 kiloms. of cable, in 1920–21 4904 kiloms., and in 1921–22 there will be more than 6000 kiloms. Telegraphic communication between Italy and abroad is in the hands of foreign companies, but it is expected that this will in part be remedied by the laying of Italian national cables to South America and to Greece. For the construction of the South American cable a company is being formed with a capital of from 75 to 80 million lire gold, subscribed principally by Italian residents in Brazil, Argentine, Uruguay, Chili, and Peru. The cable will be 13,000 kiloms. long, and it is hoped that it will be completed in three years.

The Atlas One-Cylinder Type Pass-Out Engine.

IN order to consider in any adequate manner the economical utilisation of steam in industry we have to take account of many chemical and industrial processes in which, apart from its main function of furnishing power in a prime mover, a large quantity of steam is also required for heating and other operations. It is perhaps hardly necessary to emphasise that real economy can only be obtained where the two demands are satisfied, and at the same time means are provided to balance automatically the fluctuating loads which will undoubtedly be met with on both the power and heating systems. The advantages which accrue from an installation designed in accordance with these principles are recognised, and in the paper-making industry in particular the pass-out steam turbine is successfully employed. There remain, however, many cases in such industries as paper-making, brewing, dyeing, and the manufacture of chemicals and textiles, where for outputs up to 1000 horse-power the modern steam engine may be used with profit. The advantage of the steam engine is perhaps most marked where, say, in the case of a brewery, the proportion of power required is small compared with the steam needed for heating, and again where steam for heating is exhausted to the mains at two different pressures.

The problem of the pass-out steam engine has been carefully studied by the Atlas Company, Limited, of Copenhagen, which has, especially during the last few years, supplied a large number of such engines for use in factories in Denmark and Scandinavia, where, on account of the high price of fuel, rigid economy in its use is necessary. The type of engine most frequently adopted is the single-cylinder drop valve design, with a special valve gear, and engines of this pattern have been constructed in sizes varying from 150 horse-power up to 1000 horse-power. For larger powers two cylinders may be employed. Before describing the patented arrangement of valve gear on the Atlas engine, we may call to mind the conditions under which the normal steam engine works when exhausting steam to heating mains against a fixed back pressure. Unless some regulating device is introduced it is difficult to control the load on the engine so that the exact quantity of steam is admitted to and exhausted from the engine, and in nearly all cases uneconomical working cannot be avoided, because any shortage of exhaust steam must be made up by passing additional high-pressure steam into the system through a reducing valve, or, on the other hand, when exhaust steam is delivered in excess, any surplus is exhausted to atmosphere through a loaded relief valve.

VALVE GEAR.

The object of designing a pass-out engine is to attain maximum economy of operation by so balancing the load on the two sides of the piston that, on the one side, only the exact quantity of steam required for heating is admitted to the cylinder and exhausted to the heating main, while, on the other side, the balance of high-pressure steam required to meet the load on the engine is admitted to the cylinder and exhausted to the condenser or a second heating system. Fig. 1 illustrates a 280 horse-power single-cylinder engine working with steam extraction, and in Figs. 3 and 2 we reproduce a section through the engine cylinder and a detailed drawing of the arrangement of the automatic exhaust valves. It will be noted that valves are accommodated in separate end covers, and that the cylinder is a plain casting. Steam is admitted through inlet valves A and B, and is discharged through the exhaust valves C and D to the heating mains E and F. If the engine is fitted for condensing, the simple jet condenser is usually employed, with the air pump driven from the main crank shaft. Control and isolating valves are provided, and the exhaust steam connection to the condenser may be taken from pipe E. The general disposition of the valve gear is indicated in Fig. 4. Double-seated drop valves are employed, and they are operated in the usual manner by excentrics on the horizontal lay shaft. The cut-off is regulated by the speed governor, which controls the opening of the inlet valve by altering the position of a curved lever which moves between rollers, and is attached to the excentric rod. In addition to controlling the speed of the engine, it is also desired to balance the exhaust steam and power loads, and this is done by turning to account the variation of steam pressure in the heating mains, which variation is used independently to control and to alter the cut-off in that half of the cylinder which is dealing with the heating steam. Thus, when a sudden demand for exhaust steam reduces the pressure in the heating main, the cut-off in one half of the cylinder is automatically lengthened, thereby admitting more steam, but at the same time the cut-off is reduced in the other half of the cylinder, and the balance is thereby maintained. Adjustment may be effected either by hand or by means of a special governor, which is directly controlled by the variation in pressure in the heating system.

We show, in Figs. 5 and 6, the arrangement of the governing gear for a single-cylinder engine with hand adjustment. The lever A on the speed governor is connected by the rod B to two links C, the position of these links being determined by the load on the engine. A block D is provided on each set of links, and this block is capable of independent adjustment by means of a screwed spindle operated by the hand wheel E. The movement of the link block alters the position of the excentric F, which, in turn, varies the

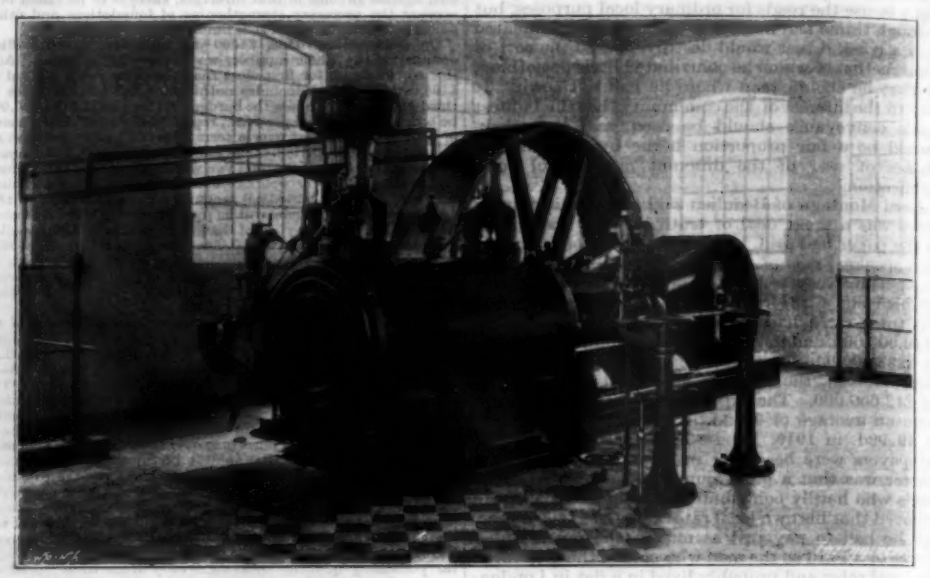


FIG. 1—280-I.H.P. ONE-CYLINDER PASS-OUT ENGINE

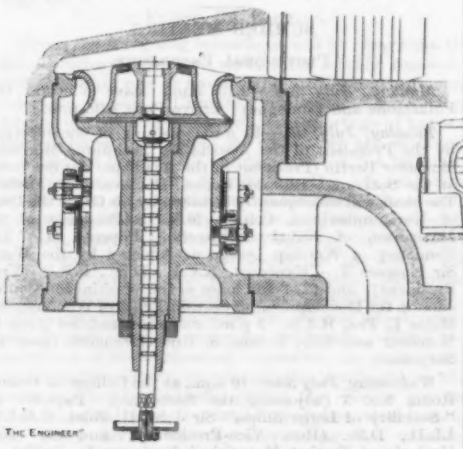


FIG. 2—SECTION THROUGH EXHAUST VALVE

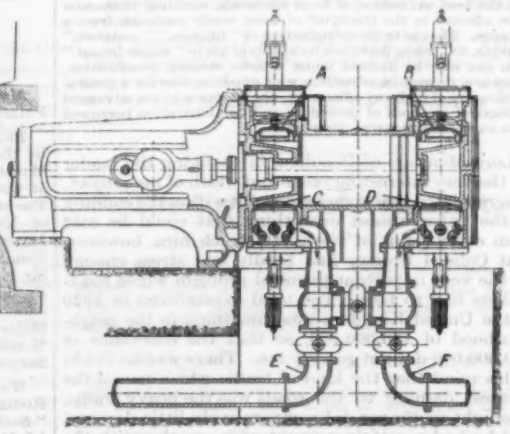


FIG. 3—SECTION THROUGH ENGINE CYLINDER

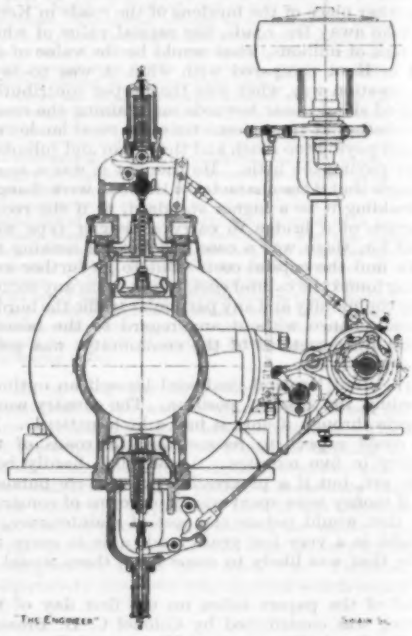
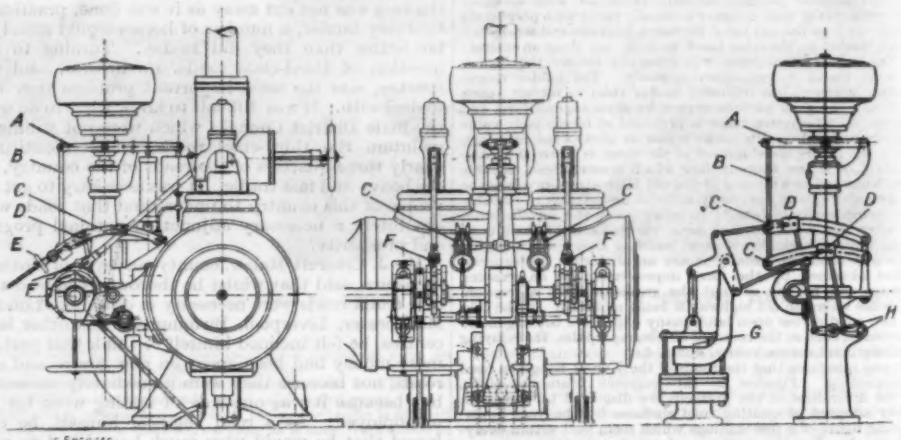


FIG. 4—THE "MANSA" VALVE GEAR



FIGS. 5 AND 6—GOVERNING GEAR WITH HAND ADJUSTMENT FIG. 7—STEAM-OPERATED GOVERNOR

cut-off by controlling the inlet valve. The excentric positions for each half of the cylinder may be varied independently, but both are simultaneously governed by the speed governor. In order to prevent the engine racing, should the load at any time be suddenly thrown off, the links are so shaped that the excentric gear will cut-off at zero when the speed governor is in its highest position, regardless of the position of the link blocks in the links. The sketch reproduced in Fig. 7 illustrates diagrammatically the same governing device, but instead of hand adjustment, a special

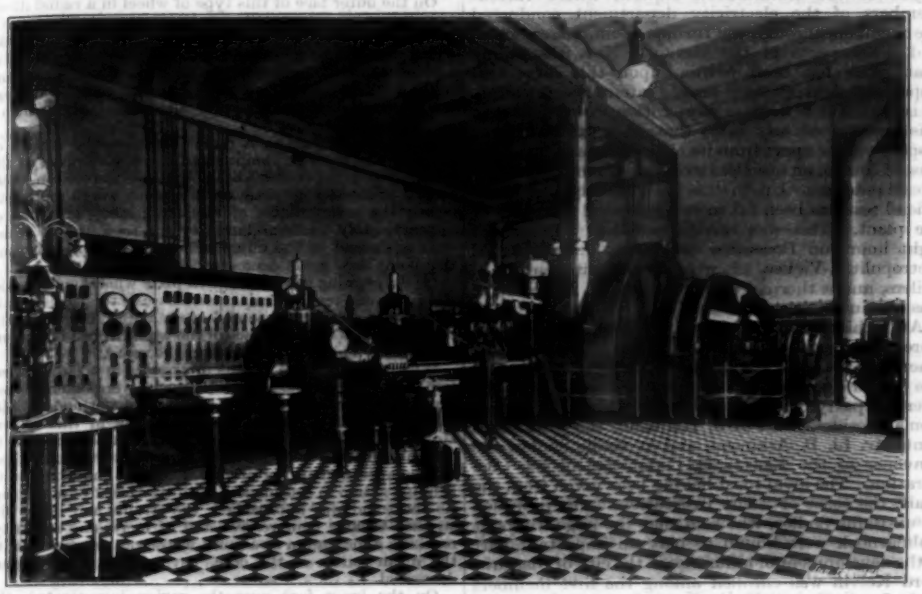


FIG. 8—750-B.H.P. SINGLE-CYLINDER ENGINE WITH STEAM EXTRACTION

steam pressure governor is provided which regulates the cut-off automatically. The lettering used in Fig. 7 is the same as that in Fig. 5, and the letters have the same signification, but the additional parts are the steam pressure governor G and the two governing shafts H which operate the excentric gears controlling the inlet valves. It will be seen that the position of the moving parts of the steam governor G is determined by the pressure of the heating steam, and this, in turn, is dependent on the amount of steam passing to the heating mains. Should the load on the engine suddenly increase and cause an amount of steam to pass in excess of the predetermined quantity of exhaust steam, the rise in pressure will cause the piston of the governor to lift, and by means of the double lever the top block D will be moved forward and the bottom block D drawn back. The mechanism is so arranged that the movement of the top block

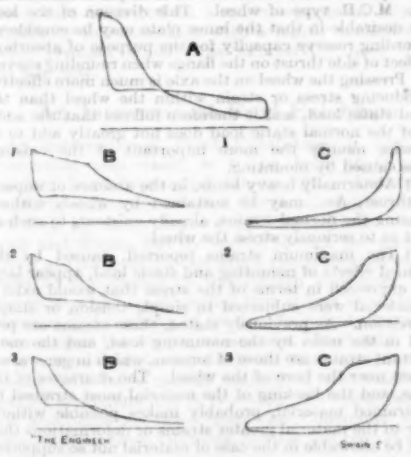


FIG. 9—TYPICAL INDICATOR CARDS

forward reduces the cut-off in that half of the cylinder supplying heating steam, and the simultaneous movement of the bottom block in the opposite direction increases the cut-off on the power side of the cylinder. By this means the quantity of steam which is exhausted to the heating main is kept constant—unless it is varied by hand—and the balance of steam required to meet the load on the engine is exhausted to the condenser in the most economical manner.

The action of the governing gear will be clearly seen from the series of indicator diagrams reproduced in Fig. 9. The set of indicator cards here shown were taken from an engine of the type we have just described, and it will be noted that the cut-offs vary considerably in the two halves of the cylinder as the demand for exhaust steam changes. The cards marked B are taken from that half of the cylinder which is working against back pressure, and is delivering steam to the heating main, and those marked C are taken from the half of the cylinder which is working on the condenser. The horse-power developed by the engine is approximately the same in each of the three cases. Attention may be called to the bottom left-hand card, which represents the conditions obtaining in the back-pressure side of the engine cylinder when working with a very small cut-off. Even under these unfavourable conditions practically no loop is shown. This result is made possible by the specially designed exhaust valve which we have previously referred to and which is shown in detail in Fig. 2. The feature of this valve is that a series of non-return valves are placed close against the main exhaust valve, and in this way the steam is prevented from getting back into the cylinder. A marked improvement in working is shown if the two lower cards marked B are compared with card A, which was taken from the same engine working with exhaust valves of the old design. With the old design of valve the loop is very marked, and the resulting loss considerable.

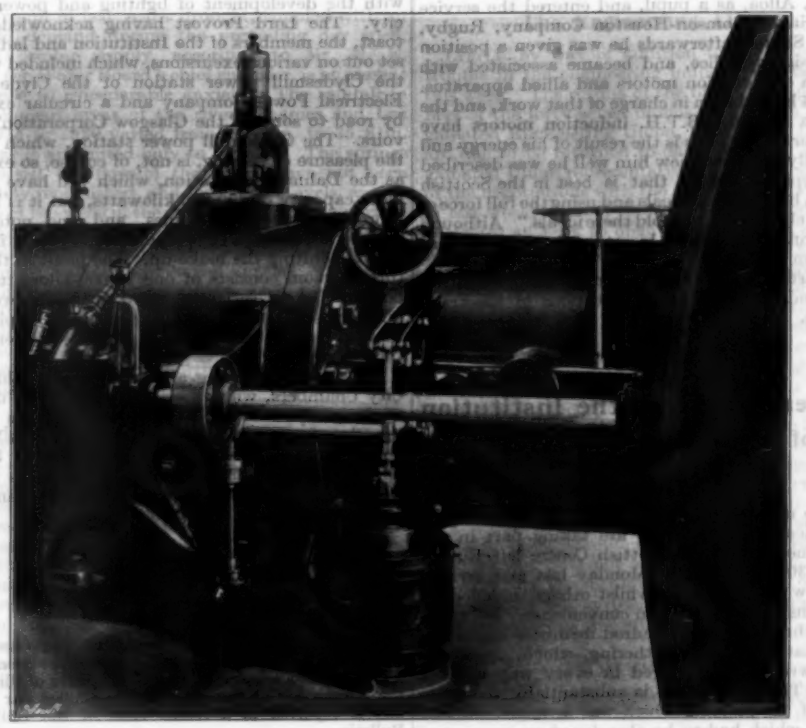


FIG. 10—STEAM PRESSURE GOVERNOR FOR RECEIVER EXTRACTION

LOG OF A TRIAL RUN.

The maximum back pressure against which a pass-out engine is capable of working is fixed by the initial steam pressure, and engines are generally built for back pressures varying from 7 lb. to 50 lb. per square inch pressure. For a back pressure of 50 lb. per square inch an initial pressure of 160 lb. to 170 lb. per square inch is required. The steam consumption varies according to the sizes of the engines and the conditions under which they have to work. As an example we give the following report of the final tests of a 280 indicated horse-power Atlas one-cylinder type pass-out steam engine, which was recently installed at the Soda Works, Limited, Copenhagen.

General Particulars.

Diameter of cylinder	19.75in.
Stroke	27.5in.
Speed	150 r.p.m.
Normal load	280 I.H.P.
Maximum continuous load	375 I.H.P.
Boiler pressure	145 lb. per sq. in.
Total steam temperature at engine stop valve	605 deg. Fah.
Type of condenser	Jet condenser.
Temperature of cooling water, average	70 deg. Fah.
Vacuum average with barometer at 30in.	26in.
Pass-out steam pressure	42.5 lb. per sq. in.

The following steam consumptions were guaranteed :—

	Full load.	Three-quarter load.	Half load.
Pass-out cylinder half, pounds per I.H.P.-hour	35	37	43
Condensing cylinder half, pounds per I.H.P.-hour	12.8	12.8	13.6

The mechanical efficiencies were :—At full load, 92 per cent. ; at three-quarter load, 89 per cent. ; and at half load, 84 per cent. The engine was designed so that under normal conditions the front half of the cylinder works condensing and the back half of the cylinder against a back pressure of 42½ lb. per square inch. As we have already described the load on the two cylinder halves is regulated by a steam-pressure governor operating on the excentric gears, and controlling through these the inlet valves, so that by varying the cut-off the exact quantity of steam required for heating purposes is admitted to the cylinder half working with back pressure, and the balance of power required is developed by the half of the cylinder which is working condensing.

For the purpose of testing the engine, two trials, each of approximately four hours' duration, were run, the first one with both cylinder halves working condensing and the second with both cylinder halves working against back pressure. We append particulars and results of these two tests.

Test I.

Boiler pressure	128 lb. per sq. in.
Pressure at engine stop valve	126 lb. per sq. in.
Total steam temperature	575 deg. Fah.
Temperature of cooling water	70 deg. Fah.
Vacuum (barometer 29½in.)	25.25in.
Speed	146.4 r.p.m.
Indicated horse-power	197.2
Total steam consumption per hour	2610 lb.
Steam consumption per I.H.P.-hour	13.2 lb.
Steam consumption per I.H.P.-hour, corrected for 145 lb. boiler pressure and 605 deg. Fah. steam temperature	12.8 lb.

Test II.

Boiler pressure	124 lb. per sq. in.
Pressure at engine stop valve	120 lb. per sq. in.
Total steam temperature	577 deg. Fah.
Back pressure	42.5 lb. per sq. in.
Speed	143.9 r.p.m.
Indicated horse-power	155.0
Total steam consumption per hour	6100 lb.
Steam consumption per I.H.P.-hour	39.4 lb.
Steam consumption per I.H.P.-hour, corrected for 145 lb. boiler pressure and 605 deg. Fah. steam temperature	34.4 lb.

We show in Fig. 8 an illustration of a 750 brake horse-power single-cylinder pass-out engine working in a large brewery.

In addition to the single-cylinder type engine which we have described, engines with two cylinders are built for large powers, and they may be arranged to discharge steam to the exhaust mains at four different pressures or to pass out steam and work with a condenser as required.

TANDEM COMPOUND ENGINE WITH EXTRACTION FROM THE RECEIVER.

The tandem compound type of steam engine may also be arranged to work with steam extraction, and such engines have been built in sizes up to 2400 horse-power. In this design of engine the steam, after doing its work in the high-pressure cylinder, passes to the receiver, where the desired amount of steam is extracted and the remainder of the steam is passed on to the low-pressure cylinder, and is exhausted to the condenser. With a suitable stop valve, pressure steam may be extracted from the receiver at pressures varying from 2 lb. to 50 lb. per square inch. The valve gear of the low-pressure cylinder is controlled automatically by a steam-pressure governor, which maintains a constant pressure of steam in the heating system, and only allows the balance of the exhaust steam delivered to the receiver by the high-pressure cylinder to pass to the low-pressure cylinder. The high-pressure cylinder inlet valves are controlled by the speed governor in the usual manner, and Fig. 8 shows the steam-pressure governor and low-pressure cylinder valve control for an engine of this type. It will be noted that the governor is provided with removable plate weights, so that the pressure of the steam which is extracted from the receiver may be varied within desired limits.

The British representative of the Atlas Company, Limited, is Mr. E. W. Dorey, Norwich House, Southampton-street, London.

Obituary.

JOHN MARTIN.

THE death is announced as having taken place on May 23rd, of Mr. John Martin, head of the alternating-current designing department of the British Thomson-Houston Company, Rugby.

Mr. Martin, who was born at Little Arduthie in 1878, was the son of the late Mr. James Martin, of Farrochie, Stonehaven, Kincardineshire. He was educated at Stonehaven and Aberdeen, afterwards studying engineering at Glasgow University, where he took the degree of B.Sc. On leaving the University he joined the works of the British Electrical Plant Company, Alloa, as a pupil, and entered the service of the British Thomson-Houston Company, Rugby, in 1903. Shortly afterwards he was given a position in the designing office, and became associated with the design of induction motors and allied apparatus. Since 1914 he had been in charge of that work, and the reputation that the B.T.H. induction motors have enjoyed for many years is the result of his energy and ability. By one who knew him well he was described as an "epitome of all that is best in the Scottish character, holding high ideals and using the full force of his strong character to uphold these ideals." Although of a retiring disposition, his staunch character endeared him to a very wide circle of friends.

Mr. Martin was an associate member of both the British and the American Institutions of Electrical Engineers.

Summer Meeting of the Institution of Electrical Engineers.

No. I.

A GOOD number of the members of the Institution of Electrical Engineers who are taking part in the summer meeting at the Scottish Centre left Euston on the 1.30 p.m. train on Monday last and arrived at Glasgow at 10.10 p.m., whilst others travelled by other trains to suit their own convenience. Roughly, between three and four hundred members and ladies are associated with the gathering, which, up to the time of writing, has proved in every way a great success. The programme is substantially the same as that of the meeting which was arranged for last year, but which had to be abandoned on account of the coal strike. On Tuesday morning the party met at the Royal Technical College, where Lord Provost Paxton gave the members a hearty welcome, and referred to the part which Glasgow had played in the development of electrical engineering. It was fitting, he said, that in the year of its jubilee the Institution should come to the city where Lord Kelvin spent so many years and carried out the work which had made his name famous throughout the world. He understood that the membership of the Institution had reached the magnificent total of 10,000, which was in keeping with the rapid progress of the electrical industry.

After the President, Mr. J. S. Highfield, had returned thanks for the cordial welcome extended to the members, Mr. R. B. Mitchell, the city electrical engineer at Glasgow, was called upon to read a paper on the "Dalmarnock Power Station." In view, however, of the fact that much has already been published upon this station, Mr. Mitchell did not enter very deeply into details, but merely described what he considered to be the most important features in connection with the design and working. Moreover, in view, no doubt, of the fact that the paper is purely descriptive and of the small amount of time available, the members were not called upon to take part in a discussion.

At the conclusion of the meeting the party was conveyed to the Dalmarnock station, where various members of the electricity department conducted the members through the turbine room, boiler-house, and other parts of the station. Notwithstanding that much has been written upon this large and important plant, the visit proved intensely interesting. It is doubtful if there is any station in existence, in this country at any rate, that is more worthy of inspection, for apart from its cleanliness and coolness, it is, of course, an excellent example of modern power-house practice. Up to the present only one semi-official test has been taken of the overall efficiency of the plant. This was carried out over a period of eight hours on December 8th, 1920, on the No. 2 Metropolitan-Vickers set, with the requisite number of boilers, and a thermal efficiency of over 20 per cent. was obtained.

After this station had been inspected, the members were conveyed to the Glasgow Council Chambers, where a luncheon was given by the Corporation in the banqueting hall. Lord Provost Paxton presided over the party, and he was supported by the Institution's President, Mr. J. S. Highfield, the past-President, Mr. Ll. B. Atkinson, and ex-Bailie Sadler, the convener of the Electricity Committee of the Corporation. The loyal toast having been given from the chair, the toast of "The Institution" was proposed by ex-Bailie Sadler, who said that the huge works at Dalmarnock were bound to play an important part in the development of industries in the city of Glasgow. Lord Kelvin was enrolled among the first members of the Institution, and he had occupied the presidential chair. Of the original founders of the Institution, only two survived, Sir Herbert Jekyll and Colonel Edward Donald Malcolm, who was a West of Scotland man. Another Scotsman who had done much for the electrical industry was Mr. H. A. Mavor. The Institution had filled its *rôle* in the highest degree, and its importance had been fittingly recognised by his Majesty the King in his bestowal of his patronage and the granting of a Royal Charter.

When the President had replied to the toast, Mr. Ll. B. Atkinson submitted the toast of "The Glasgow Corporation," and dealt in a very interesting way with the development of lighting and power in the city. The Lord Provost having acknowledged the toast, the members of the Institution and ladies than set out on various excursions, which included visits to the Clydesmill power station of the Clyde Valley Electrical Power Company and a circular excursion by road to some of the Glasgow Corporation's reservoirs. The Clydesmill power station, which we had the pleasure of visiting, is not, of course, so extensive as the Dalmarnock station, which will have an ultimate capacity of 200,000 kilowatts, but it is built on thoroughly up-to-date lines, and one noteworthy feature is that a Weir evaporator has been installed for evaporating the make-up. The plant in the main turbine room consists of one 15,000-kilowatt Metropolitan-Vickers set, and there are also two 5000-kilowatt sets, the plant being an exact duplicate of that in operation at the company's Yoker power station.

On Tuesday evening a reception was held in the City Chambers, when there was music and dancing, whilst on Wednesday morning a paper was read at the Glasgow University by Professor Magnus Maclean on "The Hydro-electric Resources of the Scottish Highlands." In the afternoon a visit was paid to Babcock and Wilcox's works, but with this and other events we shall deal in our next issue.

Chilled Iron Wheels.

AN extensive investigation concerning the strength of chilled cast iron railway wagon wheels has been carried out in America conjointly by the University of Illinois and the Association of Manufacturers of Chilled Car Wheels, and is reported in a recent issue of the University's Bulletin.

Experiments were made by pressing on to their axles several wheels of 33in. diameter and ranging in weight from 725 lb. to 740 lb. The wheels were then subjected to static loads ranging from 20,000 lb. to 200,000 lb. per wheel. Large numbers of measurements of the strains produced were made by means of a Berry gauge, which could be read to 0.0001in., and from these strains the stresses were calculated.

The authors of the report, Messrs. J. M. Snodgrass and F. H. Guldner, summarise the results of the investigation as follows:—

(1) The tensile strength of the metal taken from different parts of the plates of three wheels ranged from 23,300 lb. to 32,800 lb. per square inch, and the modulus of elasticity ranged from 14 to 28 million lb. per square inch. It is probable that these variations may be explained by variations in chemical composition of the several specimens, and variations in the treatment of the wheels after casting. Whatever the reason, however, it is suggested that a study of the metallurgy of wheel irons offers possibilities of improvement by which the higher values obtained in these tests might be consistently maintained or possibly exceeded.

(2) No distinct relation was apparent between the ultimate strength of wheel iron and either the Brinell or the scleroscope hardness, nor could a constant relation be determined between the Brinell and scleroscope results.

(3) In forcing the 625 lb. and 725 lb. M.C.B. or Washburn type of wheel on an axle the maximum tensile strain or stress is a tangential or "hoop" strain or stress occurring at the bore, and it may be on either the inner or the outer face of the wheel.

On the outer face of this type of wheel in a radial direction the strains or stresses are compressive. They are a maximum at the bore, and, in traversing the section of the wheel from the bore toward the tread, they decrease up to a point where the radius equals the mean radius of the core, beyond which an increase occurs up to a point at or near the intersection of the inner and outer plates, after which a decrease again occurs.

On the inner face in a radial direction the strains or stresses are likewise compressive and a maximum at the bore. If a similar traverse be made across the section, these strains or stresses decrease up to a point where the radius equals the mean radius of the core; they are then of approximately uniform intensity up to a point whose radius is equal to the outer radius of the core; beyond this point they again decrease.

(4) In pressing the 740 lb. arch plate wheels on the axle, the maximum tensile strain or stress was a tangential strain or stress on the inner face and at the bore. In general the tensile stresses on either face of the wheel were a maximum at the bore and decreased toward the tread.

With respect to the strains or stresses in a radial direction on the outer face, no measurements were taken in close proximity to the bore, and accordingly nothing definite can be stated concerning their intensity in this region. However, the strain in a radial direction taken nearest to the bore was relatively small and was tension in one wheel and compression in the other. This fact may be due to bending action in conjunction with the thrust of mounting. As the tread was approached, the strains and hence the stresses became compressive and of increasing intensity, reaching a maximum at a point whose radius was equal to the mean radius of the core, beyond which they again decreased.

On the inner face over the region investigated, the strains or stresses in the radial direction were compressive, reaching the maximum nearest the bore and decreasing to a minimum at a point whose radius was equal to the mean radius of the core, after which they again increased.

(5) In the regions of the chaplets and core holes, pressing the wheel on the axle causes tensile strains in a tangential direction which are of lesser intensity than, but approach in magnitude to, those at the bore.

(6) The stresses and strains in the brackets which are produced in a radial direction by mounting are relatively insignificant.

(7) The strains caused by mounting the wheels on the axles, when mounting alone is considered, are greatest in the hub near the axles. These strains, although apparently high in the case of the greatest values recorded, are steady and not repeated as is the case with the majority of strains produced in service. Moreover, these highest strains extend through a comparatively thin layer of metal near the axle, and this strained layer is backed by other layers of less strained metal.

(8) In general the static load is transmitted from hub to rail, mainly through the outer plate, while the smaller portion of the load goes through the inner plate. This effect is more pronounced in the 740 lb. arch plate than in the 725 lb. M.C.B. type of wheel. This division of the load seems desirable in that the inner plate may be considered as affording reserve capacity for the purpose of absorbing the effect of side thrust on the flange when rounding curves.

(9) Pressing the wheel on the axle is much more effective in producing stress or strain within the wheel than the normal static load, and it therefore follows that the addition of the normal static load does not greatly add to or otherwise modify the more important of the existent strains caused by mounting.

(10) Abnormally heavy loads, in the absence of impact, side thrust, &c., may be sustained by wheels without increasing the normal strains, already existent, to such an extent as to seriously stress the wheel.

(11) The maximum strains reported, caused by the combined effects of mounting and static load, appear large when expressed in terms of the stress that would exist if the material were subjected to simple tension or simple compression. As previously stated, these strains are produced in the main by the mounting load, and the more important strains are those of tension, which in general are greatest near the bore of the wheel. The character of the strains, and the backing of the material most strained by less strained material, probably makes possible without injury to the material greater strains or deformations than would be allowable in the case of material not so supported and subjected to simple tensile stress. As previously stated, the problem is one of compound stress, and the method used in computing the stresses reported is thought to give the highest values for these that could be expected under such conditions. Any error in estimating, from the stress values determined in this way, when elastic failure might take place, would be upon the side of safety. In this connection it should also be remembered that the stresses reported are those produced by two forms of wheel loading only, and that the strains and stresses resulting from these two forms of loading—mounting and static—may be materially modified by additional stress-producing factors to which a wheel may be subjected in service.

It is intended to publish additional reports dealing with tests to determine the ultimate strength of flanges, the effect of flange pressure, and the effect of brake applications, together with the related problems of brake friction and the thermal expansion of cast iron.

IT is announced by *Modern Transport* that Sir Sam Fay, the general manager of the Great Central Railway, is to succeed Sir Henry Maybury in the presidency of the Institute of Transport.

A Seven-Day Journal.

The White Star Liner Pittsburgh.

LAST Friday morning the White Star liner Pittsburgh arrived at Liverpool preparatory to her maiden voyage to Boston and Philadelphia on the 6th. The vessel carried out trials in Belfast Lough and was handed over to her owners by the builders, Harland and Wolff, on the previous day. She provides accommodation for 600 first-class and 1700 third-class passengers. The chief point of interest in her design lies in the extent to which electrical energy is used for auxiliary power and other purposes. She is equipped with a complete generating station capable of developing over 1000 horse-power. The extent to which electricity is employed on board the vessel may be judged from the fact that the total length of the distributing cable exceeds 80 miles. Electrical energy is applied to the operation of the steering gear, boat-lowering gear, cargo winches, lifts, stores hoists, engine-room starting platform equipment, sounding machines, and printing press. The clocks are electrically operated and are synchronised and controlled from the bridge. The entire cooking plant is electrically operated, and includes three large ranges, three circular roasters, a bakers' oven, dough mixers, and many small contrivances. The ventilating and heating arrangements are also electrically operated.

The Late Mr. John Temple.

THE death recently of Mr. John Temple, of Liverpool, severs a link with the earliest days of submarine telegraphy. He was born at Colne, Lancashire, in 1839, and after being privately educated became connected with the telegraph service in Leeds, Manchester and London. In 1856 he joined the Atlantic Telegraph Company on its formation, and worked on the staff of Sir Charles Bright, the engineer-in-chief. Subsequently he assisted on board the Agamemnon during the laying of the first Atlantic cable. In 1859 he entered the service of Glass, Elliot and Co., afterwards the Telegraph Construction and Maintenance Company, and for more than four years was stationed at Malta as engineer for the Malta and Alexandra and other Mediterranean cables. During the summers of 1865 and 1866 he served as third engineer-in-charge under Sir Samuel Canning on the Great Eastern while that vessel was laying the second Atlantic cable. He was responsible for picking up the first piece of the lost 1865 cable on board the grappling ship Albany. Thereafter he retired from regular service with the Telegraph Construction Company, but for many years afterwards he continued to act on occasion as engineer and agent to the company. In addition to his telegraph work, he was interested in various other commercial undertakings, particularly in the Warrington Wire Rope Works, of which company he became managing director in 1867. For a period of thirty-nine years he acted in close co-operation with the Admiralty in connection with a highly technical and secret product which was extensively used during the late war.

An International Food Exhibition.

AN international Food Exhibition, it has been announced this week, is to be held at Olympia, London, from September 6th to 26th. Its success, we learn, is already assured, for it is being supported not only by many firms supplying various kinds of foods and drinks, but by several foreign Governments which are anxious to introduce the resources of their lands to the notice of the British consumer. The degree to which engineering now enters into the preparation and packing of foodstuffs is truly surprising when a close investigation is made. It should, therefore, interest engineers to learn that machinery in motion will be a special feature of the exhibition. Special arrangements, it is stated, are being made to run aeroplane services from the Continent to the aerodrome nearest Olympia during the period of the exhibition.

Glasgow's Subway.

AFTER an existence of about twenty-five years the Glasgow Subway Railway was closed to traffic on March 25th, consequent upon the failure of negotiations for its acquisition by the City Corporation. Since that date the negotiations have been renewed, with the result that the Corporation has now decided to purchase the undertaking, and the above-ground property owned by the Subway Company, for the sum of £385,000. The subway forms a closed circular route connecting the two sides of the river and forming a convenient means of access to Govan and other important industrial districts. It is stated to have cost about one and a-half million pounds to construct and equip, and in view of the fact that the tunnels in which it runs had nearly throughout the whole length to be formed through rock, the high capital cost is not a matter of surprise. It is operated on the endless cable system, but it is understood that the City Corporation, when it assumes control, will proceed to electrify it. A Bill will have to be promoted in Parliament to ratify the sale, but it is probable that the subway will be reopened for traffic in the early future under an agreement between the Corporation and the company. Although the subway has never yielded good financial results, it has undoubtedly proved a great convenience to many users.

Wireless Investigations.

ON Friday evening of last week Mr. Marconi sailed from Southampton in his private steam yacht, the Elettra, on an Atlantic cruise for the purpose of investigating various meteorological and wireless phenomena and problems. Among the special items that will receive attention are the laws governing the propagation of electric waves from America and from England, the factors controlling the strength of wireless signals received in America from European stations, and the formation of electrical disturbances in space. It is hoped to secure information regarding the position and course of storm centres, to make experiments with direction-finding apparatus, to make tests in the high-speed reception of wireless messages, and to engage in broadcasting experiments. Numerous tests are to be conducted for the Meteorological Office with special instruments lent by the Air Ministry.

The Late Mr. Alexander Simpson.

THE death is announced, in his ninety-first year, of Mr. Alexander Simpson, of Messrs. Simpson and Rankin—formerly Simpson and Wilson—civil engineers, of Glasgow. The late Mr. Simpson was a well-known mining and civil engineer, and, in addition to being a director of the North British Railway Company, was closely connected with many railway enterprises at home and abroad. Forty years ago he was engineer to a railway in San Domingo, which was promoted by some Glasgow merchants. He was also engineer for the North British Railway's underground section in Glasgow, and for the extension of the West Highland line from Fort William to Mallaig. He was responsible for the design of the Glasgow Subway, which, as recorded above, has just been taken over by the City Corporation.

London's Water Supply Threatened.

As a result of last year's drought, coupled with an increased demand during the prevailing dry spell, London's water supply, according to Mr. H. E. Stilgoe, the Water Board's chief engineer, is at present giving rise to considerable anxiety. The rainfall in the catchment areas of the rivers Thames and Lea from 1915 to 1920 varied from 29.55in. to 35.81in. Last year it amounted only to 16.52in. The springs which assist the flow of the rivers have not been adequately replenished, and their water levels, as well as those of the wells in the chalk, from which a portion of the London supply is drawn, are at present very much below the average. At the same time the consumption of water is above the normal, 300 million gallons having been consumed last week, as compared with 250 millions in the week before and 240 millions a month ago. Garden watering is stated to be the chief cause of this increase, and, as was the case last year, it may be necessary shortly to impose restrictions on the use of water for this purpose.

A Large Trades Union Combination.

LAST week we recorded the fact that at the annual conference of the Associated Society of Locomotive Engineers and Firemen a large majority vote was registered in favour of the proposal to link up the organisation with the National Transport Workers' Federation. At the conference of the Railway Clerks' Association at Southport at the end of last week the same proposal was also considered, but was referred back to the branches. At the same time an overwhelming majority was recorded against a resolution authorising the executive to take steps to bring about a fusion of the Association with the other railway unions.

The St. Lawrence Deep Waterway Scheme.

IT is officially announced that the Canadian Government does not consider the present moment an opportune one for the conclusion of a treaty with the United States regarding the proposed St. Lawrence deep waterway scheme. A description of this project appeared in our issue of March 10th. It consists of the construction of a series of short canals with locks, whereby the St. Lawrence would be made navigable from the Great Lakes to the Atlantic, together with the construction of power-houses at several of the locks. Opinion in Eastern Canada has never been very favourably inclined towards the scheme, for it was held that it was primarily intended to benefit the exportation of wheat and maize from the Middle Western States of the United States and to secure to American capitalists the right to exploit still further the water power of the St. Lawrence. The Montreal and Quebec harbour authorities are also opposed to the scheme on the ground that if carried out it would reduce the water level of the lower St. Lawrence—already in some respects too low—to an impracticable extent. The Canadian Government's decision not to consider the scheme at present is thought to imply that it will not again be advanced for a good many years to come.

Disinfecting Liners.

THE United States Government now insists that the first and second-class accommodation on big liners shall be fumigated at proper intervals. For this purpose hydrocyanic acid gas—that is, prussic acid gas—has become popular in the United States, but in this country sulphurous acid gas, in spite of its disadvantages, such as the damage it does to furnishings, is chiefly used. At a meeting in London on Monday of port sanitary authorities strong views were expressed against the use of hydrocyanic acid gas, on account of the elaborate precautions which must be taken with it to prevent fatal accidents and the difficulty of obtaining a satisfactory respirator for those charged with the duty of effecting the fumigation. Two large vessels have been fumigated recently at Liverpool with hydrocyanic acid gas, but on the second occasion, it is stated, an accident was narrowly avoided. Loss of life as a result of using the gas has occurred in Italy. It is understood that the Ministry of Health is now investigating a disinfecting gas which possesses the non-damaging properties of hydrocyanic acid without its highly poisonous nature.

Sir Eric Geddes' New Appointment.

IT is officially intimated that Sir Eric Geddes, the late Minister of Transport, has been elected a member of the board of directors of the Dunlop Rubber Company, Limited. It is of interest to note that Sir Guy Granet, another railway authority and a member of Sir Eric's Government Economy Committee, is also a member of the Dunlop board. The Dunlop Company, during the year 1920–21, after making various allowances, showed a net loss of about £8,300,000, largely as a result of the fall in value of the stocks of rubber in hand.

The Engineering Dispute.

LITTLE by way of addition to the history of the trouble in the engineering industry can be recorded this week. The results of the ballot among the members of the forty-seven unions, other than the Amalgamated Engineering Union, involved in the dispute are due to be returned to-day (Friday). The Amalgamated Union representatives, following the rupture of the negotiations with the employers on Wednesday of last week, decided to call a national conference of delegates at York to open to-day. What will be the outcome of that conference there is little to indicate, but as regards the other unions a feeling prevails that the result of the ballot will be favourable to a resumption of work on the employers' modified terms. The ballot paper contained no express recommendation one way or the other from the executives of the three groups of unions. In addition to setting forth the employers' terms in full, it contained an important note relating to payment by results. In this note it was stated that the Employers' Federation had agreed that no system of payment by results would be introduced in the month immediately following the date of the resumption of work, and that during that period they would enter into negotiations with the union representatives for the purpose of arriving at an agreed basis for the introduction of such systems. This arrangement does not affect any existing agreement providing for the introduction of systems of payment by results, while systems at present in operation are for the time being to continue in force.

Sir William Noble.

ON the last day of May Sir William Noble retired from the position of engineer-in-chief at the General Post Office. He began his official career as a telegraphist at Aberdeen, his native town, and passing through the position of engineer-in-charge of the Aberdeen section, was appointed in 1901 assistant superintending engineer in the Central Metropolitan District. In 1912 he became assistant engineer-in-chief, and in 1919, on the retirement of Sir William Slingo, succeeded to the post of engineer-in-chief. He was knighted in 1920, in recognition of his able work for the Post Office, which work was largely concerned with the telephone services. He has been succeeded by Major T. F. Purves, formerly assistant engineer-in-chief. We understand that Sir William Noble has accepted a seat on the board of the General Electric Company, Limited, and that he proposes to devote his attention mainly to the development of the telephone and wireless sections of that company.

Developments in Power Station Design.

No. XXXII.*

IT is a perfectly well-recognised fact that the air used for cooling turbo-generators should be clean, for the accumulation of dirt within the windings of electrical machines impairs ventilation and is almost sure to lead to trouble sooner or later. From time to time we have described air filters suitable for power-house use. In a short series of articles, which appeared in our issues of January 1st and 8th of 1915, we discussed various types of cloth and water-spray filters which were then available, whilst in our issue of March 24th of this year we dealt with the "Visco" filter, which has a filtering medium composed of a mass of short rings which are cut from very thin coppered tubing, and covered with a thin film of mineral oil termed "Viscinol." Much diversity of opinion exists concerning the relative merits of different kinds of filters. There is no doubt whatever that some of the early cloth types were unsatisfactory, both from the point of view of purifying the air and in respect of keeping the filtering medium clean. But air filters are now available which can perform their duty much more satisfactorily than those which were used in the past. Heenan and Froude, of Worcester, for example, have introduced a wet filter which dispenses with sprays, so that the presence of loose moisture in the air is avoided. The body of the filter which is rectangular—see Fig. 193—is built up of steel plates, which are stiffened, where necessary, with angles, and are mounted on a base which forms a tank. The filtering effect is obtained by drawing or forcing the air through two sets of screens which are fixed one behind the other in the front part of the filter. These screens are composed of metallic wood of standard size and thickness, and held together between frames of expanded metal. In order that the air may be thoroughly cleaned, a flow of water is passed continuously over the screens by means of a small centrifugal pump, which delivers the water to the top of the screens. After percolating through the screens, the water falls into the tank at the bottom of the filter, where it passes through a strainer and returns to the pump to be re-circulated. Access to the screens can readily be obtained, and they can easily be removed, although, owing to the fact that they are continuously washed with water, cleaning is seldom necessary. The dirt, &c., is carried together with the water to the bottom of the filter, where it can be removed through sludge doors. After the air has passed through the screens it travels through a series of eliminator plates, which are fixed at a suitable distance from the screens. These eliminators are claimed to catch any small particles of loose moisture that may have passed the second screen. The total resistance to the passage of air through the apparatus does not, it is said, exceed .75in. water gauge. In addition to cleaning the air, the process obviously has a great cooling effect, the temperature of the air being reduced to within a few degrees of the prevailing wet-bulb temperature. Experiments are said to have shown that the danger of loose moisture being carried into the alternator is completely overcome. A definite water level is maintained in the base or tank of the apparatus by an ordinary float valve connected to the water supply, the amount of water used being, of course, the quantity lost by evaporation in passing through the filter. The main advantages claimed for this filter are:—(1) High cleansing efficiency; (2) positive cooling effect; (3) the cooling and cleansing operations are carried out by water-washed surfaces and not by sprays; (4) entire freedom from loose moisture; (5) simplicity and lack of necessity for highly skilled attention; (6) accessibility of all parts; (7) durability owing to small number of moving parts; (8) reliability; (9) small space occupied; and (10) no fire risk.

A more or less new and very interesting method of dealing with the air used for cooling turbo-generators has been devised by the Metropolitan-Vickers Electrical Company, and it was recently described in a paper read before the Institution of Electrical Engineers by Mr. J. A. Kuyser. In this arrangement, which is shown in Fig. 195, the air-circulating system is completely closed upon itself. The air passes through the generator, where it is heated, then through a water cooler, where it is cooled, then back again through the generator, and so on. The cooler, it will be perceived, is composed of tubes with water inside, so that there is no risk of the air taking up moisture, and the only dirt that can be deposited in the machine is that contained in the original volume of air which fills the air-circulating system. This amount of dirt is, of course, a negligible quantity, and the possibility of troubles arising as the result of imperfect ventilation is very remote.

As regards the cooling arrangements of turbo-generators themselves, the Parsons schemes shown in Figs. 196 and 198 are well worthy of consideration. Preferably the stator shown in Fig. 196 is ventilated by a separately driven fan, the air inlets and outlets being arranged along the base or top of the stator casing as shown. The stator casing is divided into a series of separate narrow transverse compartments

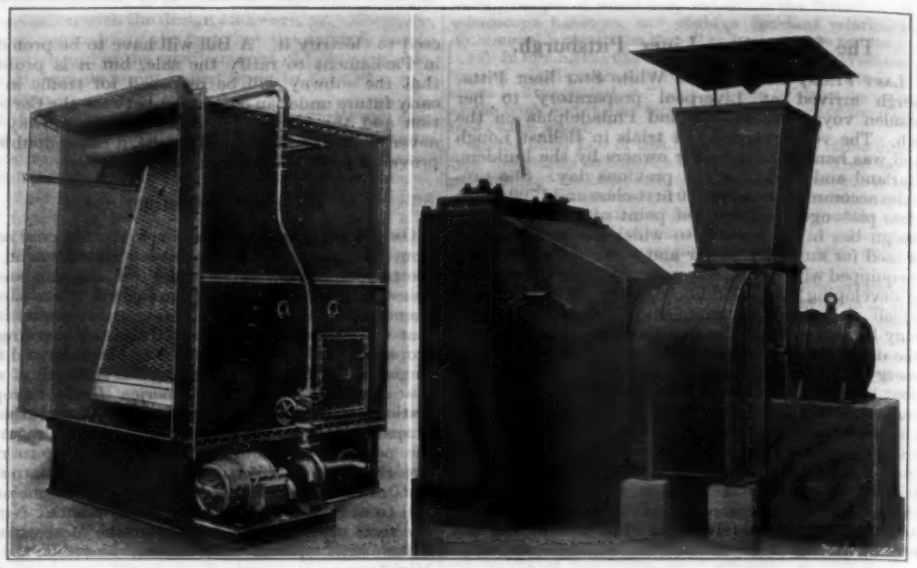


FIG. 193—HEENAN AND FROUDE AIR FILTER

FIG. 194—THE SERCK AIR BLAST COOLER

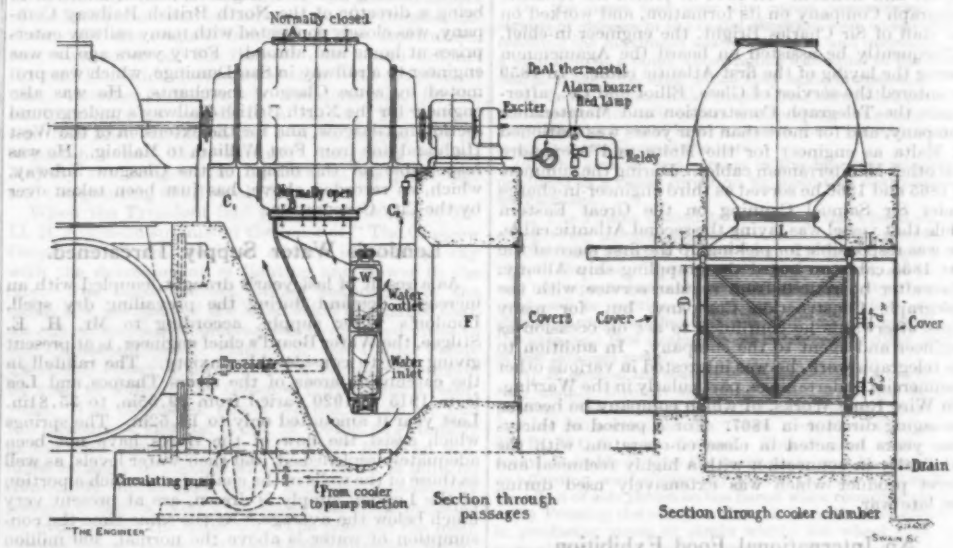


FIG. 195—METROPOLITAN VICKERS VENTILATING SYSTEM

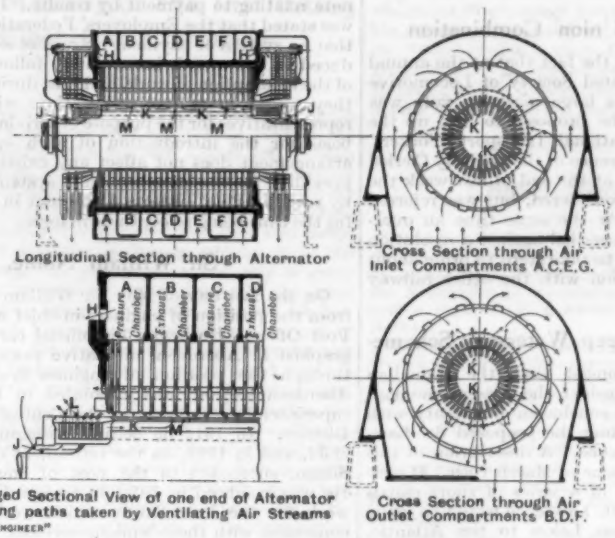

Longitudinal Section through Alternator
Cross Section through Air Inlet Compartments A.C.E.G.
Enlarged Sectional View of one end of Alternator showing paths taken by Ventilating Air Streams
Cross Section through Air Outlet Compartments B.D.F.
"THE ENGINEER"

FIG. 196—PARSONS SYSTEM OF ALTERNATOR STATOR COOLING

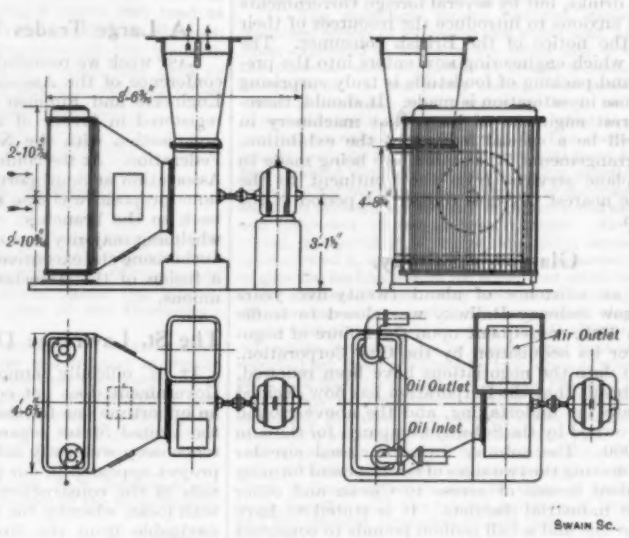


FIG. 197—ARRANGEMENT OF AIR BLAST COOLER

* No. XXXI. appeared May 26th.

A B C D E F G, and by connecting each alternate compartment A C E G to the air trunk, and the remaining compartments B D F with the air outlet duct, fresh air has access to all the parts of the machine, and an alternator of any desired length can be built. The end compartments A and G of the casing are pressure compartments, and cool air is

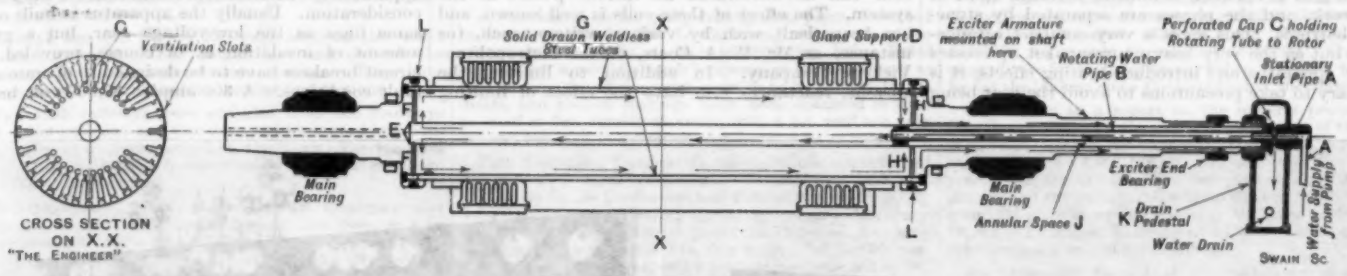


FIG. 198—PARSONS WATER-COOLED ROTOR

blown through the ports or holes H into the end windings, baffle plates being provided to direct the air over all these windings before leaving the air outlets at the bottom of the end shields. It will be seen that this method of cooling, which is covered by the British patent No. 15,585 of 1914, also enables the rotor body to be uniformly cooled by the streams of air reaching it from the stator core ducts. Air also has access to the end windings of the rotor through grooves J, which are machined in the rotor below the balancing discs. The air is induced to flow in these places by the centrifugal action of the air already inside the end caps and in the vacant slots K machined along the poles. The air is discharged through holes L drilled in the end caps, and through gaps M between the keys of the pole slots, situated at points opposite the exhaust compartments B D F in the stator.

In addition to the usual air surface ventilation, water is sometimes used for cooling the rotor, as shown in Fig. 198. The rotor is composed of a solid forging, which has a centre longitudinal hole. The cooling water is pumped through a fixed pipe A into the rotating pipe B, which is connected to the rotor by means of the cap C. The other end of this pipe is fitted with a water-tight gland D, so that the water is made to traverse the entire length of the central passage through the rotor. At the extreme end E of this passage radial holes F conduct the water to solid-drawn weldless tubes G, which are embedded at the bottom of the winding slots, as shown in the cross section. The heated water from the tubes at the bottom of the slots flows back to the centre of the rotor through radial holes H, and re-enters the central passage on the other side of the water-tight gland support D, and it then flows along the annular space J and emerges into the drain pedestal K through holes in the cap C. With this form of construction, which is covered by British patent No. 16,986 of 1914, all the water joints and plugs in the rotor are outside the stator bore and the end shields, so that in the event of any water leakage taking place at these points, it can at once be noticed and attended to. The water plugs are arranged at L, in Fig. 198, and the position which they take up with respect to the stator is shown by the arrow in Fig. 199. The water used for cooling the rotor is circulated by a small pump in a closed system, and the same water is used continuously. The heated water which leaves the rotor passes into a tank from which it is pumped through a surface cooler on its way back to the rotor. Preferably the cooling water is taken from a branch on the main condenser circulating water supply pipe.

Whilst dealing with the question of cooling, attention may be directed to the air blast cooler shown in Figs. 194 and 197. This has been designed by the Serck Radiator Company, Limited, of Warwick-road, Greet, Birmingham, for cooling the oil used in turbine bearings, transformers, &c., with air, where the use of water may be undesirable. Because of the fact that air cooling is much less efficient than water cooling the apparatus is much larger than a water cooler of the same capacity, the dissipating capacity of the particular plant shown being 90 kilowatts, or 305,000 B.Th.U. per hour. The cooler is composed of large diameter steel tubes with grills fitted on the outside. The oil is pumped through these tubes, which are expanded in top and bottom headers, whilst air is drawn through at high velocity over the outer surfaces. Oil coolers of the water type are also made by this firm.

FIG. 199—A PARSONS ALTERNATOR FITTED WITH WATER-COOLED ROTOR

The increase in the size of modern power stations has made it necessary to pay very careful attention to the design of switchgear. The fact that every circuit breaker on the bus-bars may have to deal with a short circuit fed by the greater portion of the synchronous plant on the system has resulted in a great increase in the size and capacity of central station switchboards. The design of oil circuit breakers which can deal with the short circuits of the kind that are liable to be experienced on systems fed by several large power stations has been very far from an easy task, and as in the future electricity supply schemes may become still larger, it is desirable that the capacity of switchgear for new stations should be based on the ultimate plant capacity. Investigations in connection with the short circuit characteristics of modern steam turbo-alternators have shown that the instantaneous value of the short-circuit current is only limited by the machine reactance, and attains a value which is ten or twelve times greater than the full-load current; but by the time the circuit breaker has opened this value has been reduced to approximately six times the full-load current. To appreciate the importance of this point it is essential to realise the great magnitude of the currents that will flow under short-circuit conditions with the usual pressures, which, in this country, are, as a rule, 6600 and 11,000 volts. Switches must be capable of

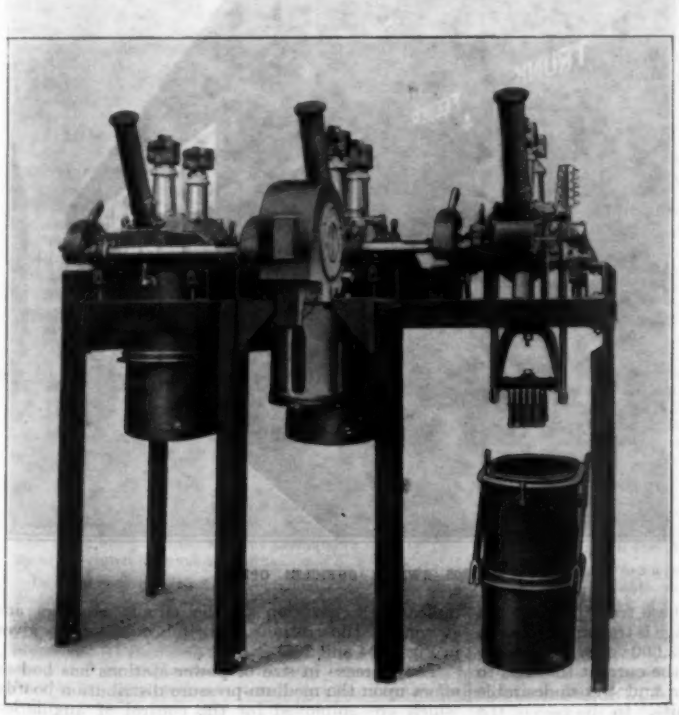


FIG. 200—2500-AMPERE, 11,000-VOLT CIRCUIT BREAKER

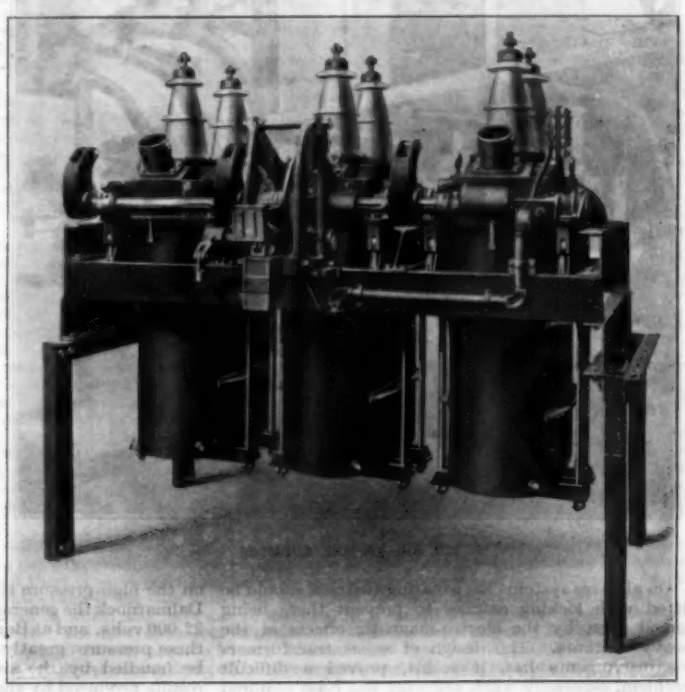


FIG. 201—300-AMPERE, 33,000-VOLT CIRCUIT BREAKER

dealing with heavy currents under normal conditions, and circuit breakers must be capable of withstanding the mechanical stresses resulting from heavy short-circuit currents. A 2500-ampère 11,000-volt electrically operated circuit breaker built by the Metropolitan-Vickers Electrical Company is shown in Fig. 200 on page 609.

The usual switchgear structure in which the high-tension gear is enclosed is built of artificial stone or brickwork, and the phases are separated by stonework barriers. This gives a very compact arrangement, but as the very heavy currents set up stesses in the apparatus and introduce heating effects, it is necessary to take precautions to avoid the gear being damaged. Take, for example, a three-phase 6600-volt system supplied with plant having a capacity of 75,000 kVA. Assuming a 16in. bus-bar spacing, the resulting maximum load per foot run of the bus-bars and connections with a symmetrical three-phase short circuit would be in the neighbourhood of 2200 lb. in the first half-cycle, and it therefore follows that it is essential to support the bus-bars adequately in order to prevent movement taking place in consequence of this heavy loading. The heat developed by these heavy currents would also be excessive in conductors of small capacity, and calculations show that on a system such as that mentioned the conductors should not be less than 0.25 square inch in area.

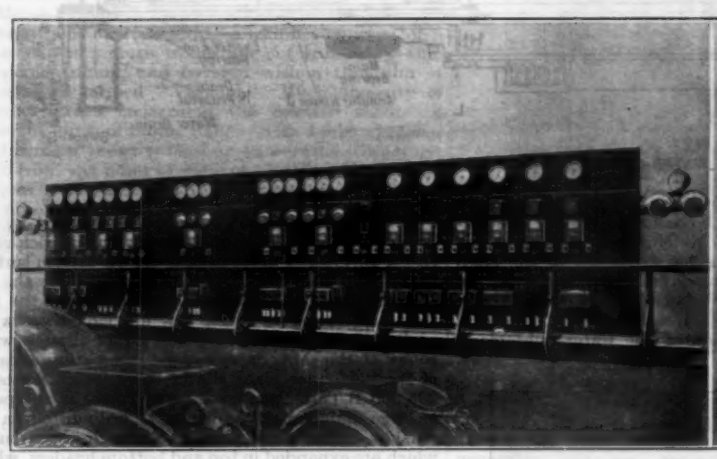


FIG. 202—VERTICAL TYPE SWITCHBOARD

FIG. 203—DESK TYPE SWITCHBOARD

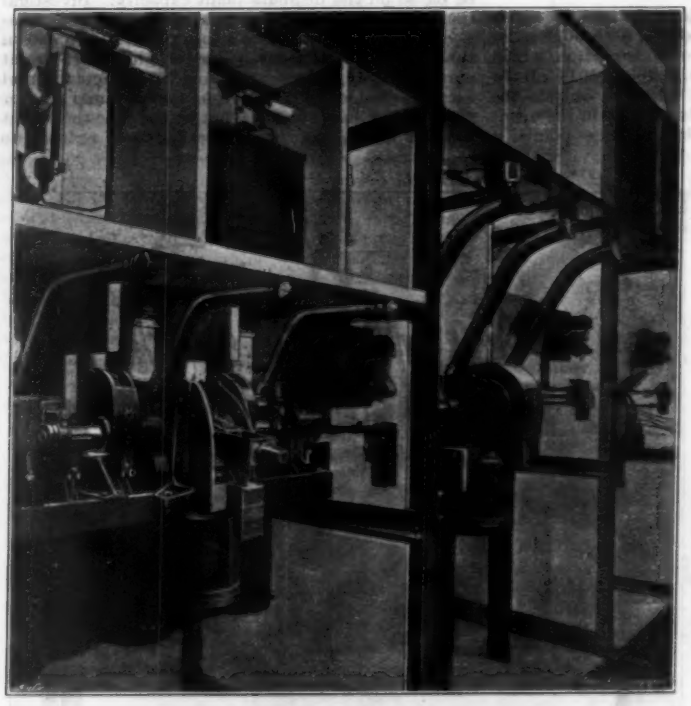


FIG. 204—SWITCH CUBICLES

FIG. 205—SWITCH CUBICLES OPEN

On all large systems the isolating switches should be fitted with locking catches to prevent them being forced open by the electro-magnetic effects of the heavy currents. The design of series transformers for instruments has, it seems, proved a difficult problem, especially when accuracy has been required on low ampère capacity circuits. On heavy current circuits a series transformer with bar type primaries constructed to meet the B.E.S.A. specification can be used, but on circuits of less than 300 ampères capacity accuracy with this type of transformer cannot be guaranteed, and if accuracy is needed it is essential to use a wound transformer, which under fault conditions is subjected to severe stresses. Potential transformers are usually protected by fuses, but they are quite inadequate on large systems. It is now becoming common practice to put reaistances in circuit with these transformers to limit the fault current to a value within the capacity of the fuse. All the precautions and elaborations mentioned naturally increase the cost of switchgear. The troublesome effects mentioned can be minimised in other ways, but these entail still greater expense. Reactance coils can be introduced at various points in the system. The effect of these coils is well known, and has been dealt with by various writers, such, for instance, as Mr. W. A. Coats, of the Metropolitan-Vickers Company. In addition to limiting the current, reactances also have the effect of limiting the voltage disturbance very largely to the section on which the fault occurs. A very heavy fault naturally reduces the station voltage, and as most stations supply synchronous machinery which will drop out of step and shut down with a large drop in pressure, the results are liable to be anything but desirable from the point of view of supply authorities and their consumers. When reactances are connected between bus-bars, however, this fall of voltage would be confined largely to the faulty section.

Another method of reducing detrimental effects of heavy currents has been adopted at Dalmarnock and Barton. The machines generate at a pressure of 6600 volts, and all the switching operations are done on the high-pressure sides of these transformers. At Dalmarnock the generator voltage is transformed up to 22,000 volts, and at Barton to 33,000 volts. Obviously these pressures greatly reduce the current that has to be handled by the switchgear and the undesirable results produced by short circuits. In the case of the 6600-volt system referred to above, the load per foot run of the bus-bars would be reduced to approximately one fortieth of the figure given, owing to the lower currents and increased spacing. It is considered that this system will probably be widely adopted in the future in connection with large stations which are outside their areas of concentrated supply, and possibly reactances will also be used to limit the disturbances on the system. A combined scheme of this kind has, in fact, already been adopted at the Barton station.

The space required for switchgear which works at the above voltages becomes an appreciable factor in the lay-out of the station. With the artificial stonework type of cubicle at least two floors are required for accommodating the apparatus, so that access can be gained to all the parts. In the design of the apparatus the insulation problem calls for the greatest consideration. Usually the apparatus is built on the same lines as the low-voltage gear, but a greater amount of insulation is, of course, provided. Oil circuit breakers have to be designed to operate under fault conditions. A 300-ampère 33,000-volt breaker of this kind is shown in Fig. 201. This breaker is designed for mechanical operation, and is provided with strong tanks.

The switching arrangements are controlled from a central position, and the main circuit breakers are electrically operated. The control board may either be of the vertical type, as illustrated in Fig. 202, or of the vertical type, as shown in Fig. 203. No high-pressure circuits are brought to these boards, and in present-day schemes even the direct-current operating currents are made and broken by contactors which are mounted in the cubicle structure and are controlled from the operating panel. Signal lamps or a mimic diagram, or a combination of both, indicate the position of the circuit breakers and switches. Illustrations of switch cubicles are given in Figs. 204 and 205.

The increase in size of power stations has had an effect upon the medium-pressure distribution boards, which are employed for the control of auxiliaries. If all the auxiliaries are electrically operated, this power may be supplied from separate medium-pressure sets or from step-down transformers connected to the main bus-bars. In either case, and more especially in the latter case, the breaking capacity of the medium-pressure circuit breakers should be carefully considered, otherwise troubles are liable to occur in consequence of the circuit breakers having too small a short-circuit capacity.

Railway Matters.

YESTERDAY the 8.30 a.m. Continental Boat Train from Victoria, South-Eastern and Chatham, left at her new time, 9.15 a.m., and is due in Paris only a few minutes later than formerly.

THE Runcorn-Weston Point new light railway was opened on the 22nd ultimo. It will facilitate the service between Runcorn station, Runcorn docks and the Castner-Kellner alkali works.

A YEAR ago the Burma Railways adopted the tablet system for working their single lines and ordered the necessary instruments for sixteen sections. They have now ordered instruments for a further five sections.

THE Irish railways were excluded from the Railways Act of last year and are, therefore, not interested in grouping. We hear, however, that the Cork, Bandon and South Coast is about to be absorbed by the Great Southern and Western Company.

A VALEDICTORY letter, signed by the Chairman and Directors of the Cambrian Railways, has been sent to every member of the staff of that line—now absorbed in the Great Western system—conveying the very sincere good wishes for the men's future welfare.

IN our leading article of the 19th ultimo, on Railway Rates, we mentioned that practically no reduction in rates had been made in the United States. Cable advices now show that from July 1st all rates are to be reduced by 10 per cent. Further, that the "fair returns" mentioned in the Transportation Act, 1920, is to be 5½ per cent. and not 6 per cent.

THE death, after an operation for appendicitis, is announced of Mr. F. J. Angier, superintendent of timber preservation of the Baltimore and Ohio Railroad. He was probably the leading authority—certainly the principal writer—on the subject of timber preservation. He was for thirteen years the secretary to the American Wood Preservers' Association, and was made its president only as recently as last January.

ACTIVE progress is being made with the work of electrifying the Central of Brazil Railway, upon which an expenditure of 60,000 contos of reis (approximately £2,900,000), has been authorised. Work has been commenced upon the first of the 53 miles of the section of the railway carrying the most traffic, and upon the construction and distribution of the signal systems for four sub-stations. Orders have been placed for 22 electric locomotives and 150 motor carriages.

THE East Coast Companies are to be commended on their announcement that an express goods train leaves King's Cross at 3.40 p.m. each week-day, except Saturday, calls at Sandy for vegetable traffic, and is due in Edinburgh at 2.45 a.m. and Glasgow 5.40 a.m. We believe that both the London and North-Western and Midland Companies have for years had such a fast train to Glasgow. The speed by the East Coast is 393 miles in, say, eleven hours. Only vacuum-fitted wagons will, of course, be used.

ON the 15th ultimo Mr. Arthur Neal was asked some questions on the alleged over-crowding on the London omnibus and underground routes, and what action did the Government intend to take in view of the fact that £5,000,000 had been granted to the traffic combine under the Trade Facilities Act?" The Parliamentary Secretary to the Ministry of Transport replied that this subject had been the matter of several general inquiries, and the whole question would, no doubt, be considered by the Royal Commission on London Government. The matter was under continual observation by the departments concerned.

THE Government, on the 9th ultimo, secured the second reading in the House of Commons of the Canals (Continuance of Charges) Bill, which is to extend for twelve months the rates in force which would, under the Ministry of Transport Act, 1919, revert to pre-war charges in February next. In 1920 the tonnage carried was 14,250,000 and there was a deficiency on revenue account of £1,800,000. In 1921 the tonnage was only 10,250,000 and so it is essential to continue the present charging powers for some little time longer. The Bill is the result of forty or fifty companies intimating that if the Government did not do something they would themselves have to deposit Bills for such powers. Possibly in Committee the period may be made for longer than twelve months. The Canal Association has been asked to make a recommendation thereon.

THE railway authorities in Victoria are about to introduce a rail motor car on an outback line. The object is to develop traffic while at the same time economising in operating costs. The new car is a petrol-driven five-ton motor lorry, the chassis of which was built by the A.E.C. Company. The railway department stripped off the wheels and steering gear, extended the chassis frame to a total width of 6ft. 10in., and placed on it a car with seating accommodation for 43 persons. A trailer for the car has been constructed at the railway workshops and will seat an additional 12 persons, while space is provided for two tons of freight. A maximum speed of 25 miles per hour is anticipated. If the initial car is a success, others will be put in service. A feature of the car is that adjustable steps are provided so that passengers may be picked up or set down at level crossings.

IN connection with the electrification of the Chilean State Railways between Santiago and Valparaiso (116 miles), and the branch from Llai-Llai to Los Andes (28 miles), considerable progress upon construction is reported. By the terms of the contract, the work has to be completed by September 27th, 1923; but progress has been so satisfactory that it is expected that electric trains will be running over part of the line by the end of the current year. Four classes of electric locomotives are being employed—high-speed express passenger engines for the through passenger service, passenger locomotives for the local trains, goods locomotives and shunting engines. The express passenger and the freight locomotives are being arranged for regeneration. The first goods locomotive, which has now been practically completed, is rated at 1680 horse-power at 3000 volts and will be able to develop a maximum of 3000 horse-power for short periods.

Notes and Memoranda.

SOME bars of iron, said to date back to pre-Roman days, have recently been discovered, buried at a depth of about 1ft. 6in., near Winchester. Analysis shows that they have the following composition:—Combined carbon, 0.06 per cent.; silicon, 0.11 per cent.; sulphur, 0.014 per cent.; manganese, faint trace, and in another specimen none; nickel, faint trace; phosphorus, 0.954 per cent.

A PROCESS of centrifugally casting steel pipes, described in the *Iron Age* by Mr. L. Cammen, makes use of an extremely hot mould, as high as 2000 deg. Fah. Metal cast against a mould of such temperature cools so slowly as to give time for all slag and gases to to be thrown to the inside, and perfect castings have been obtained in sizes as small as 3in. outside diameter, with a ¼in. wall not only in steel but in such a difficult metal to handle as monel.

THE Australian Customs Department has approved of the following tariff decisions:—Electric machines and appliances for the production and distribution of electricity from brown coal, including lightning arresters, frequency absorbers and parts, switch gear, transformers, &c., may be admitted under Item 174, free under the British preferential tariff, 5 per cent. under the intermediate and 10 per cent. under the general tariff; wire, ribbon, hardened and tempered, for use in the manufacture of surveyors' measuring chains, Item 404, free, free, 10 per cent.

IN replying to the discussion of a paper on Oil Fuel, read before the Institute of Marine Engineers, Mr. A. Keens said that in all probability—if the present type of marine boiler is retained—the future oil burning boiler will be slightly longer than the present practice. The extra space thus got will be utilised as extra depth of the combustion chamber. In short, the combustion chambers and furnaces will be made as large as conveniently possible. The tubes may perhaps remain about the same length. This arrangement would give the extra combustion space that appears to be desired.

THE Masindi district of Uganda is said to contain enormous deposits of iron ore. A Government report indicates that there is a large quantity of ore of the lateritic type capping many of the hills, but, apart from this, hematite and magnetite are locally abundant and of economic importance. It is suggested that a small modern iron-smelting furnace might be successful in meeting local requirements. High-grade ore exists and also dolomite for fluxing; there is also water transport for the movement of these materials, but the fact that coal has not yet been found in the country would necessitate the employment of charcoal. The question of electric smelting of the iron ores is also under consideration, and it is said that in one district it should be possible to produce pig iron by this means at £6 a ton.

IN a paper read before the American Society of Mechanical Engineers, Mr. Charles G. Adsit said that the amount of available power at Muscle Shoals on the Tennessee River is much exaggerated in the published reports. In accordance with the hydrograph of the river at this point the amount of strictly primary power at Muscle Shoals averages 60,000 horse-power, and even this figure is based on the assistance of some steam capacity which must be maintained. The contemplated capacity of 400,000 kilowatts could be operated at full load only at widely separated intervals since the river does not yield this amount of power except on an average of less than thirty consecutive days per year. In 1904, for instance, the flow would have produced only approximately 50,000 kilowatts for a large part of the year.

A FIRE which had obtained a strong hold on some timber sheds and piles in America, was extinguished by means of cement. The method of application was that of scattering dry cement over piles adjacent to the fire. This was then wetted down with water from buckets. Thin cement was also applied to the timber which was ablaze. This appeared to act very effectively by caking over the fire and smothering it down, and thus, by preventing sparks from flying, greatly reducing the danger. The dry cement, applied and wetted on to the piles not alight, rendered them practically fireproof, and the whole result was attained with surprising suddenness. In another case, in a conflagration of a tank of 400 gallons of oil in the basement of a building, the damage was reduced to a minimum by throwing into the blazing oil several sacks of dry cement.

THE progressive increase in horse-power used in the transmitting stations of wireless telegraphy and telephony, which has been observed by M. Henri Deslandres, is referred to in the *English Mechanic* as follows:—When the first French station was established at the Eiffel Tower only 3 horse-power was used in each signal. In 1910 this was raised to 75, in 1914 to 150, and before the end of the war to 300. When in 1915 a station was constructed at Lyons, in case the Eiffel Tower should be destroyed by the enemy, the transmitting horse-power was 450. In the station erected at Bordeaux it was 1500. The station now in construction at Ste-Assize, near Melun, has a horse-power of 2000. In the United States of America a station is under construction with a power of 10,000. The rate of propagation of a wireless wave is one million times faster than that of a sound, a signal taking only one-fifteenth of a second to reach the Antipodes.

IT appears from a paper by Prof. Kerr Grant, of the University of Adelaide, published in the "Proceedings" of the Physical Society of London, that there is some possibility of producing sound more efficiently than is the case with the average fog-signalling installation, which may have an efficiency so low as 2.4 per cent. The new apparatus makes use of the vibrations set up in a thin metal plate a foot in diameter. A stream of air or liquid issuing from a flanged pipe, the flange of which is placed near and parallel to the plate, impinges on the latter. The arrangement is a reproduction on a mechanical scale of the scientific toy illustrating Bernouilli's law of flow of fluids, in which a sheet of paper is placed on the end of a flanged pipe and attempts are made to displace the paper by blowing up the tube. In the sound producer, the surface of the flange is made convex to the plate, and the edge of the latter is provided with a strong rim to which the pipe and flange are attached in a way to provide for adjustment of the distance separating flange and plate.

Miscellanea.

ACCORDING to a report received from H.M. Trade Commissioner at Wellington, New Zealand, the demand for lorries, particularly petrol-driven, has been considerable since the war. The number of petrol lorries in use now is much larger than in pre-war days, and there is no doubt that their use is capable of still greater increase.

THE Electric Supply Committee of the Melbourne City Council earned revenue amounting to £356,446 during 1921. Expenditure totalled £235,655, and the gross profit, £121,790, represents an increase of £5000. The capital expenditure for the year amounted to £169,919, which was by far the highest since the inception of the undertaking.

ACCORDING to a report on the mineral production of New South Wales for the year 1921, the value of the output of minerals during last year was £14,018,648, representing an increase of £2,607,186 as compared with the previous year. This amount has been exceeded only in 1918, when minerals to the value of £14,419,352 were produced. The quantity of coal wrought during the year amounted to 10,793,387 tons, an increase of 77,388 tons in 1920, and constituting a record for Australia.

ON September 25th, 1911, the battleship Liberté blew up in Toulon Harbour through the explosion of ammunition on board, the disaster resulting in the loss of 240 lives. The wreck, which projects above the surface of the water, has always been a serious hindrance to navigation, but it was only in August of last year that the Minister of Marine contracted with a private firm to refloat the vessel. The removal of the ammunition was completed in February last, and since then arrangements have been made for floating the wreck, an operation which, it is expected, will be effected within fifteen months of starting operations.

WE admit to finding it very difficult, says the *Architect*, in an article entitled "Architectural Humour," to know what the average woman trained on a course of the *Daily Mail* and frequent Building Exhibitions does want, but we imagine it to be a clever combination of the advantages of an operating theatre and of a mediæval cottage, something which will automatically spurn dust and yet have the mellow softness given by centuries. This should be situated in some charming situation with southern aspects on all sides excepting in the height of a hot summer, when by a little ingenuity the aspects should be made reversible.

IN connection with the Centennial Exhibition, a hydro-electrical congress will be held at Rio de Janeiro under the presidency of Dr. Simoes Lopes, Minister of Agriculture of the Brazilian Government. The congress will discuss all questions pertaining to water-power developments which are about to engage the attention of the Federal Government, and also of several of the Provincial Governments, notably Minas Geraes and Sao Paulo. As a result of the congress and the known desire of the Federal Government to encourage the hydro-electrical industry in Brazil, it is expected that a large number of contracts for the utilisation of water-power will result.

ARRANGEMENTS have been completed for the amalgamation of influential interests connected with the electrical industry of Argentina, with special reference to the provision of electrical plants and raw materials, including the production of power and light-generating plants. A powerful company is being formed for the undertaking of operations throughout South America, by reason of which it is hoped that British materials and electrical plants will be considerably popularised. Special attention will be given to the supply of electric light and power in the form of small installations suitable for villages and private dwellings. Arrangements will be made with municipal councils to install generating stations and to co-operate in financing the cost.

THE Bradford Educational Authority is devoting its attention to a subject of general interest to manufacturers and contractors in this country. Under the Fisher Education Act boys are debarred from leaving secondary schools until the end of the term in which they attain their sixteenth birthday, the maximum age at which apprentices usually commence their training. In the opinion of Bradford manufacturers this prevents the entry into trades of numbers of lads of superior education, and is likely to have a detrimental effect upon the standard of work. The Chairman of the Educational Authority therefore advocates a revision of apprenticeship regulations, although it would appear that the object would be more easily obtained by a suitable revision of the Fisher Act.

WE are informed that the repairs to the structural part of the river Tyne swing bridge which the River Tyne Commissioners have decided to take in hand immediately are to be carried out by the engine works department of Sir W. G. Armstrong, Whitworth and Co., Limited. It is now forty-seven years since Messrs. Armstrong designed and built this bridge at Elswick, and we believe these are the first considerable repairs that have had to be faced. It is interesting to note that the foreman in charge of the repairs—Mr. William Davison—was employed in 1875 on the construction of the bridge at Elswick Engine Works under Mr. P. D. Westmacott and Mr. Hamilton Rendel. It was on June 15th, 1876, that the bridge was first opened to traffic. The bridge will not be closed to traffic during the repairs.

THE Institute of Physics has under consideration the publication of a journal dealing with methods of measurement and the construction and use of instruments, to be called "A Journal of Scientific Instruments." The journal will be managed by a committee appointed by the Institute of Physics on which the Department of Scientific and Industrial Research and the National Physical Laboratory will be represented, and the editorial work will be carried out at the N.P.L., assisted by a scientific advisory committee appointed by the Institute of Physics. It will probably consist of 32 pages, and will be published monthly at 2s. 6d. per issue. The Institute will only find it possible to make itself responsible for the journal if its financial position is secured; and as a means of ascertaining what support may be expected a specimen number for free issue has now been published. Anyone desiring a copy of this number is asked to apply to the Secretary of the Institute of Physics, 10, Essex-street, London, W.C. 2, and to enclose 6d. to cover postage.

MILLENNIUM FLOUR MILLS, VICTORIA DOCK, LONDON

HENRY SIMON, LIMITED, MANCHESTER, ENGINEERS

(*For description see page 616*)

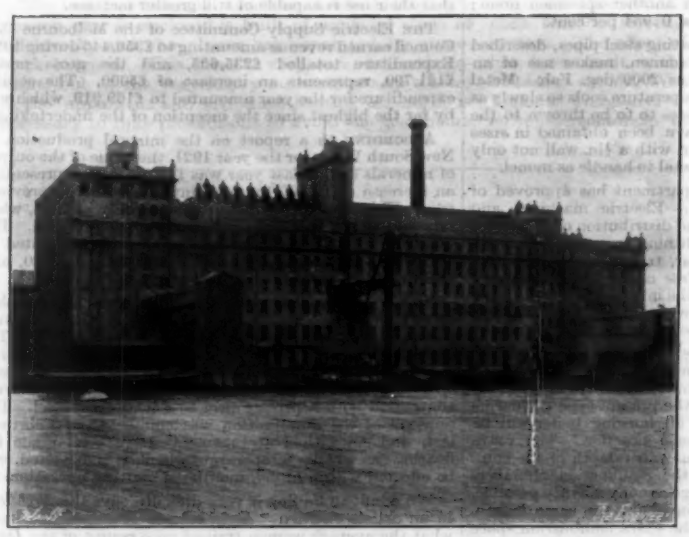


FIG. 1—FRONT VIEW OF THE MILLS FROM THE DOCK SIDE

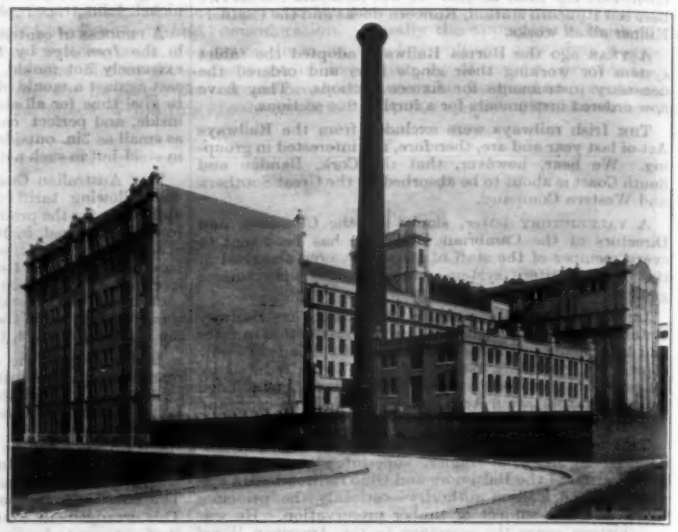


FIG. 2—REAR VIEW OF MILLS, SHOWING WAREHOUSE

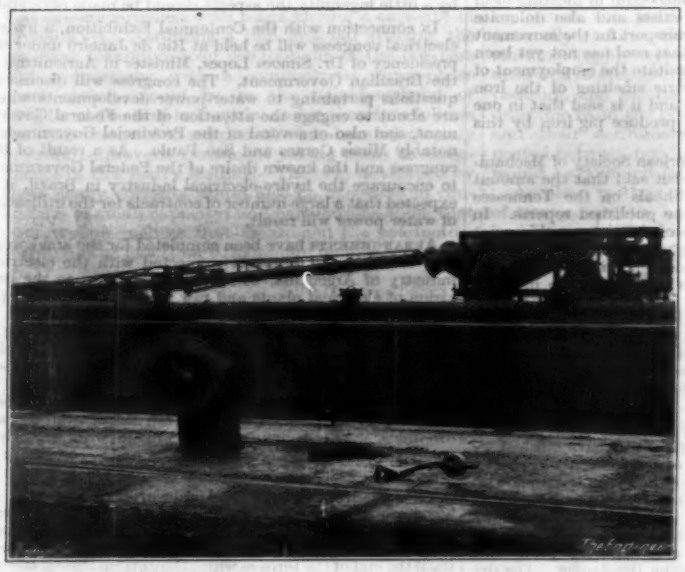


FIG. 3—PNEUMATIC PLANT WITH PIPES IN STOWED POSITION

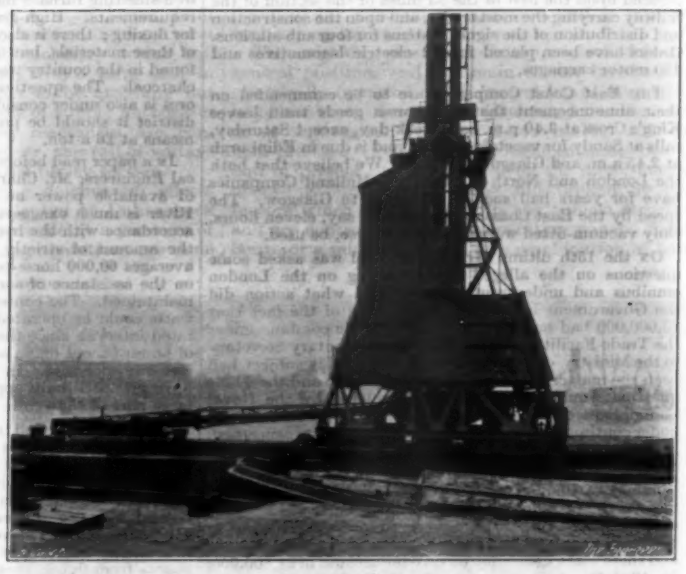


FIG. 4—PNEUMATIC PLANT PASSING UNDER BUCKET ELEVATOR

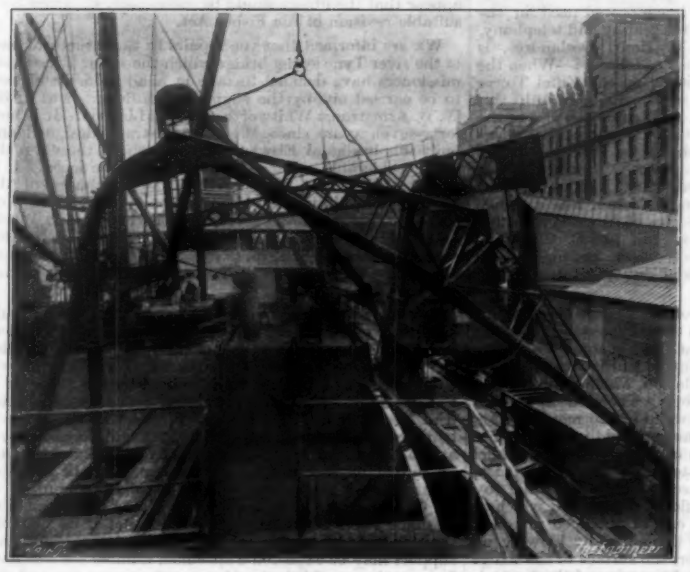


FIG. 5—PNEUMATIC PLANT IN OPERATION

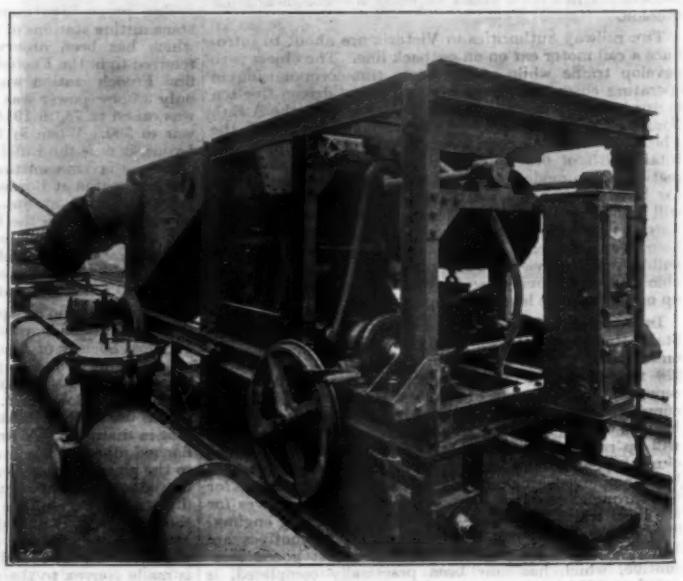


FIG. 6—PNEUMATIC PLANT—THE CARRIAGE

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TWO-PAGE SUPPLEMENT—THE FLOOD PROBLEM IN CHINA.

THE ENGINEER.

JUNE 2, 1922.

Bearing Metals.

THERE are numerous indications which serve to show that of late years engineers have not devoted as much attention to the whole subject of bearing metals as at one time they did. Nor is it difficult to understand such an attitude. On the one side, the development of such devices as the ball and roller bearings and the Michell bearing, together with forced or pressure lubrication, tends to allow the engineer to think that this troublesome matter of bearings has been more or less completely settled. On the other hand, stereotyped specifications of long standing for such things as Admiralty bearing metals suggest that in regard to the materials for bearings themselves something like finality has been reached. Yet in fact such a view is very far from accurate. It is true that, under conditions of modern efficient lubrication, the nature of the bearing metals seems to be of smaller importance than formerly, but recent research on lubrication has shown that the behaviour of a bearing depends very largely upon it. The fact that the chemical nature as well as the physical properties of a lubricant is of primary importance in determining the friction developed at once suggests that some sort of chemical action takes place between lubricant and metals. It seems quite probable that it is for this reason that the presence of a small percentage of fatty acids is valuable in a lubricating oil.

The importance which is attached elsewhere to this subject is indicated by the publication in Germany of a special volume, by Czochralski, on bearing metals. This book deals exhaustively, not only with the various kinds of bearing metals, but also with a new method of testing the efficiency of a bearing by determining the temperature rise which takes place under steady running under heavy loads. While such a principle of testing has been previously used in this country for special purposes, its application to an extensive series of tests is new and interesting. It certainly suggests that our engineers and metallurgists cannot afford to neglect the subject. One of the most interesting sections of this book deals with the new type of bearing metal consisting of an alloy of lead with a small percentage of the alkaline earth metal barium. It has long been known that the alkali and alkaline earth metals, when alloyed with lead, confer hardness upon it. The use of a lead-sodium alloy was suggested as a substitute for the ordinary lead-antimony employed for shrapnel bullets. The hardening of lead obtainable by the aid of barium, however, appears to be very considerable, and the resulting alloy shows remarkable value for bearing metal purposes. This alloy has been exploited in America as well as in Germany, mainly, in the first place, under pressure of war conditions resulting in scarcity and excessively high price of tin. That such a lead-barium alloy should conform to some of the most important requirements of a bearing metal is not surprising. One of these requirements appears to be that the alloy should consist of a relatively soft and ductile matrix in which are embedded a large number of small hard crystals or particles. The ductility, it may be supposed, enables the bearing as a whole to adapt itself easily to the shaft under load, while the hard particles resist wear. It is, further, probable that, the hard particles standing in slight relief, allow a certain freedom of motion to the thicker oil film which must form over the slightly depressed regions occupied by the soft matrix. The lead-calcium alloy no doubt consists of hard particles of a lead-calcium compound embedded in a matrix of only slightly hardened lead. Only two misgivings arise in regard to such an alloy. They both relate to its probable stability. First, from the chemical point of view, barium is itself an element of great activity which tends to be rapidly attacked by oxygen, moisture and carbonic acid. Alloying it with lead very greatly reduces these tendencies, and in a bearing where it is kept covered with a film of oil, a good deal of protection is given. None the less, a certain degree of caution may be necessary, particularly where marine uses are concerned. From the physical side also there may be ground for doubt. An alloy of such relatively low melting point cannot be assumed to possess stable and permanent hardness. Lead itself undergoes rapid and spontaneous softening—really annealing—at the ordinary temperature, and it is, at the least, a matter requiring full experimental proof that these very much hardened lead-calcium alloys may not also, in the course of time, and particularly when slightly heated in a bearing, undergo gradual softening.

We have referred above to certain essential qualities in any bearing metal, but they are by no means the only important properties. This point may be realised from considering for a moment the well-known fact that in the great majority of cases any given metal or alloy will not run satisfactorily in a bearing of its own material. The reason is not very clearly understood, but it would seem that, in spite of good lubrication, there are times when slight projections on shaft and bearing are brought into actual contact under pressure during running. This action is often accompanied by local heating, and the result is more or less complete seizure—the two metals, in the language of the workshop, "pick up." This phenomenon is most marked in the case of the softer metals of low melting point, and it is well known how readily it occurs when two surfaces of aluminium or of aluminium alloys are run in contact. Between different metals in contact with one another such partial and local "welding" does not occur so readily, and one can only imagine that the two widely different kinds of metallic atoms cannot interlock so readily when brought into intimate contact. Yet, in other circumstances, as when copper is electro-deposited on steel, or nickel on copper, the strength of adhesion obtained is at least as great as that between successive layers of, say, copper on copper. One difference, however, lies in the fact that the surface of the bearing metal is locally, at all events, in a condition of severe cold work, and if we follow the ideas of Sir George Beilby, such a layer is, for the time being, in a temporarily mobile state specially favourable to a welding process under pressure. We have here, clearly, a problem of very considerable interest. Nor is this interest merely of an academic nature. The question of finding some means whereby, for example, an aluminium alloy piston could be made to work well in an aluminium alloy cylinder in an internal combustion engine, without the intervention of the steel or iron liner, is one of immediate importance in regard to engines for aircraft and for automobiles. The problem of bearing metals, in the widest sense of the term, cannot therefore be regarded as by any means closed.

Heavy Suburban Passenger Train Working.

THE South-Eastern and Chatham Joint Managing Committee, having decided to convert that company's lines in the London area from steam operation to electric traction, there remain, of the companies operating in London, only the Great Western, Midland, Great Northern, Great Central, and Great Eastern with no electrical suburban services. From this list the first-named may almost be withdrawn, as the Great Western is a joint owner with the Metropolitan of the Hammersmith and City Railway and furnishes the track between the

Metropolitan Railway proper and the Hammersmith and City, and it has also provided the Ealing and Shepherd's Bush Railway, over which the Central London trains run. Moreover, the Midland is in this list for a time only, as it is under a legal obligation to convert its Tilbury lines, and that work, no doubt, will be done as soon as the financial outlook—combined with the railway grouping situation—permits. The Great Northern and Great Central have, comparatively, little suburban traffic. For the remaining company, the Great Eastern, no reservation can be entered. Its suburban traffic is, excluding the purely Underground services, the densest of the lot, and its main London terminus, Liverpool-street, is the busiest station in the world.

One of the reasons given at the time for the appointment, eight years ago, of Sir Henry Thornton was that he was the superintendent of the Long Island Railroad. That railway had a very dense suburban traffic, and its lines, in connection with the opening of the Pennsylvania new terminal in New York City and the consequent entry of the Long Island Railroad into Manhattan, were being converted to electric traction. He had, therefore, just the experience that the Great Eastern needed, and in fact he brought forward a very fine scheme for the electrification of the Great Eastern lines, including the use of the existing connection with the Metropolitan Railway and the provision of a junction with the Central London. That plan, however, has gone no further. War broke out four months after Sir Henry's arrival, and since then it has been futile to discuss so great and so costly a scheme. Now another difficulty has arisen under the grouping of railways. The Great Eastern is to be in the eastern group, along with the Great Northern, Great Central, North-Eastern, Hull and Barnsley, North British, and Great North of Scotland. As matters are to-day, the Great Eastern, compared with some of ths lines we have just named, can well stand comparison, but were it tied to a big scheme for electrification and for the reconstruction of lines in and approaching Liverpool-street, there might be an element of uncertainty as to its future prospects, and, therefore, its financial standing in the group might be prejudiced. Furthermore, we must recall that there has been in operation for nearly two years a steam train service which is certainly unbeaten by any other steam-operated service here or abroad. In July, 1920, the Great Eastern introduced a greatly improved service on the Chingford, Enfield, and Palace Gates branches. Not only was the number of trains increased, especially during the rush hours, but the accommodation and facilities were extended and standardised so as to quicken up the movements of arriving and departing passengers. These improvements, we may recall, are principally due to Mr. F. V. Russell, who read a paper on suburban train working at the concluding meeting of the Institute of Transport Congress a fortnight ago. He was the Great Eastern running superintendent until Sir Henry Thornton, soon after his arrival, reorganised the departments and made Mr. Russell the superintendent of operation. The improvements were made in various ways. Trains run at equal minutes after the hour during the slack and busy hours, but as the trains are made in units, one unit, two units and three units suffice for slack, busy and rush periods respectively. The existing locomotives are used, and most of them are of sufficient power to deal with the lighter trains during the day, leaving the larger engines for the rush traffic. At terminal stations the water columns are fixed so that an arriving engine takes water whilst the carriages behind it are being unloaded and refilled, and the engine then follows the train out and goes into a dock to await the arrival of the next train, on to which it is coupled in readiness for its fresh journey. Each platform road has its own engine dock, and each is occupied in sequence, and as entrance into one road means the fouling of other roads there is a four minutes' interval in the departure of trains at the period of entry instead of a two minutes' interval. In the busier hours arriving trains miss certain stations so as more equally to divide the loading. The signals were rearranged more in order to suit the timing of the trains than to give a running view; any deficiencies in the latter respect being compensated for by "repeater" signals. Outer "homes" were fixed to allow for quicker acceptance of trains, and electrical contacts to secure prompt clearances of passing trains. Lock-and-block, which has been a feature on the Great Eastern, and which has undoubtedly assisted towards its excellent freedom from collision, has been retained.

But excellent as the Great Eastern is, Mr. Russell admits that more could be done with electric traction, and that is the most important fact conveyed by his interesting paper. Profoundly as we believe that the steam locomotive has still a long future for main line working, we are under no illusion as to its defects for suburban work when contrasted with electric traction. Whether all the merits enjoyed by the latter are ascribable to the fact that the source of power is electric, we are not prepared to say. It is well nigh impossible in large affairs to make one change without making others, and the introduction of electric suburban traffic is no exception. It has always been accompanied by an improvement of stations, rolling stock, and so on, and by extensive advertisement, which has led to more building and hence to more passengers. For terminal handling it has, however, unquestionable advantages of the highest order, and it is a striking fact that Mr. Russell, who has made every effort to bring suburban steam traffic up to the electrical standard for rapidity, was yet bound to admit the superiority of the latter. But sooner or later, even with an electrified line, the double-decking of Liverpool-street Station will have to be undertaken, and we should dearly like to see the effect tried with steam- or internal combustion hauled trains built on electric train models.

Marine Surveys.

By E. LATHAM and P. HARRISON.

MARINE surveys are in most cases required as a preliminary to designing and constructing piers, quays, jetties, or wharves. This class of survey differs essentially from ordinary field work and from geodetic surveys of precise character covering large areas. As the major portion of the work has to be done afloat, methods which would otherwise commend themselves on the grounds of their mathematical accuracy have to be abandoned and others proved practicable by experience have to be introduced.

Geological considerations and the nature of the sea or river bed in regard to their suitability for carrying the foundations of structural works are excluded from this article, which is confined to the following subjects :—

(*a*) Levelling.
(*b*) Soundings.
(*c*) Current observations.

The above subjects are dealt with below :—

(*a*) *Levelling.*—Levelling in connection with proposed marine works is necessary to establish the exact relation between the bottom levels obtained by soundings and the foreshore levels between high and low-water mark and to determine their collective relationship with Ordnance Datum.

Observations with a "Y" or dumpy level are of a much more precise character than any observations which can be obtained with sounding lines or rods, and it is therefore always desirable that the levelling work on any range should be carried out at the period of the lowest available spring tide, and that there should be a distinct "overlap" between the soundings and the shore observations taken on the same range. This appears a simple result to obtain, but in practice it is difficult to secure. Wind, weather, and barometrical conditions materially effect low-water level, especially in estuarial waters, and L.W.O.S.T. is an extremely vague datum (physically as apart from mathematical calculation).

In connecting up the work of levelling with the corresponding soundings the following points have to be considered. The most favourable period for taking soundings is the short time during which slack water occurs at the bottom of the tide, and, leaving out exceptional cases, this gives the observer who takes the soundings not much more than two hours per diem, to work in, and the fall and rise of tide is then only a matter of a few inches. This, of course, only applies to soundings taken with a lead and in several fathoms of water. Where a sounding rod can be used the tidal currents cause less interference, and the period available for observation is longer. As soundings are taken from floating craft drawing a definite amount of water, it is clear that the soundings cannot be advanced shorewards much beyond extreme low-water mark. To secure the definite overlap with the levelling referred to above, it therefore follows that soundings should be taken where possible at neap tides at or near the time of low water.

A station point for referring all levels to must be established in the immediate vicinity of the sounding area, and this station point must be referred to a bench mark of known accuracy. In many cases dealt with by the writers, this question of known accuracy has proved troublesome. Unless the bench marks established by the Ordnance Survey are of recent date, their accuracy, especially in marsh lands and in the vicinity of recent dredging operations, is very much open to question. A considerable revision of the Ordnance Survey is now in operation, but many of the minor lines of triangulation are not yet completed. In respect of recent levelling in the parish of Vange, Essex, it was only possible to establish a reliable datum by working from a new Ordnance bench mark and applying to the Department at Southampton for information as to the level of the same. It frequently is necessary to ignore the local marks and to tie up the whole survey to a reliable bench mark (preferably on high ground) free from the liability of being affected by surface land movement. The term "surface land movement" is deliberately employed, as this is by no means confined to subsidence, experience having shown that in soft ground such as wet clay or a peat formation, subsidence over any given area is liable to be accompanied by an actual elevation round the perimeter of this area.

(*b*) *Soundings.*—Civil engineers adopt a variety of methods in taking soundings, and each engineer as a rule adopts a special method. As a result of experience in trying several methods, the following conclusions have been arrived at :—

The survey methods commonly employed are—

(1) Pre-determining landmarks ashore and "lying off" each range with a steel cable moored to the shore and marked at appropriate intervals (two observers).

(2) Using the same procedure as in (1), but avoiding sinkage of the steel cable by employing a buoyed line (two observers).

(3) Taking spot soundings over the area and signalling ashore to two observers each stationed with a theodolite at opposite ends of a pre-determined base line (three observers).

(4) Taking spot soundings over the area concerned and sextant observations afloat to at least three known marks ashore (two observers).

(5) Sextant observations in a boat ranged in on two marks ashore but to a third mark at the end of a predetermined base line (two observers).

(6) The same method as (5), but observing the angle from the shore by an observer stationed at the end of the base line, *i.e.*, at the third mark (two observers).

The number of skilled observers quoted above is in addition to the observer always required in such surveys for the purpose of reading the tide gauge or otherwise checking the changes in water level by staff and levelling instrument. In some cases this duty can be combined with the other duties of one or other of the observers ashore, but it is in general not a course to be recommended, as it is liable to lead to confusion.

The use of a motor boat, curiously enough, is not an advantage, as craft of this kind are most difficult to hold on bearings, and two watermen, skilled in their craft, and an ordinary open boat, weather permitting, give the best results.

It may, therefore, be taken that for the purposes of securing soundings with any degree of accuracy, a survey party of at least five or six persons is required, including watermen. Taking into consideration the fact that at least two of the party must be trained surveyors, and that work is limited to a maximum of about two hours a day, the expensive character of this work can easily be realised.

In considering the relative merits of the six methods detailed above, it is clear that methods (1) and (2) are liable to be unsatisfactory. In practice, unless under exceptional conditions, the readings on the ranging line will not give the true distance from the boat to the station point ashore. In the case of steel cables the error is principally due to the submergence of the cable, and it is impossible to judge the extent of this error as entanglements frequently occur with obstructions on the sea or river bed. Method (2) is better than method (1), but the slightest wind or tide will "bow-out" the line, which it is impossible to keep taut. These methods can, however, be used if a definite mooring or anchorage can be secured at the sea end of the line, but such precautions are slow, expensive and unduly elaborate.

Methods (3) and (4) are useful where great speed is necessary. The observer afloat with the sounding line can take his observations with extreme rapidity, ignoring his exact location, as the only precaution he has to take is to see that he covers the area with a sufficient number of soundings close enough together to enable contour lines of the sea or river bottom to be established by proportional measurements, made afterwards in the drawing-office. The approximate profile of any desired range can, of course, be established from the contours thus obtained. These two methods cannot be regarded as giving extreme accuracy, as it will be noted that the method of obtaining contours pre-supposes a constant gradient between any two soundings. Method (3) is preferable to method (4), and is simply illustrated in Fig. 1. The base line $x\,y$ is established ashore, and while for example the sounding z is being taken, two observers note the angles θ and a.

Experience has shown one very important point, and that is the absolute necessity of arranging beforehand a clear code of signals between observers ashore and afloat. In taking soundings the observer afloat gives the signal, takes his sounding and books a consecutive number. If the sounding is unsatisfactory, he repeats it, but he must *re-signal* and take his second attempt as a separate sounding; otherwise there is great danger of confusion occurring between the relative soundings and the respective angular observations, and valuable time is wasted.

Methods (5) and (6) are to be preferred, in almost every case, as likely to give the most reliable and

accurate results. Both methods are based on the same principle, but method (6) is the best. Fig. 2 illustrates this method. A pre-determined base line *b c* is established ashore, and the marks *a* and *b* erected. The boat is held on the line *a b d* by ranging *b* with *a*. Soundings are taken at frequent intervals by the observer in the boat, and he is able to note any marked changes in depth, so that he can group his soundings close together or at wider intervals as changes in the bottom may indicate as desirable. Soundings are signalled ashore and the varying angle θ observed with a theodolite at point *c*. In the diagram the angle *c b d* is shown as a right angle, but the range line may bear a greater or less angle to the base line, provided the intersection of lines *c d* and *a d* do not become too acute, thus introducing errors in location. This method has the obvious advantage that the ranges can be carefully selected beforehand to fit closely into any projected scheme of works. Fig. 3 illustrates a profile taken in the manner described, and the table below shows the actual observations made at a recent survey of Horseshoe Bay. The table is useful as giving an illustration of a practical form which the surveyors' field book may take for this class of work.

It cannot be too strongly emphasised that all soundings should be reduced to the level of Ordnance Datum, as cases have arisen in which considerable confusion existed owing to this precaution not having been observed. If soundings are reduced to Ordnance Datum, depths of water can be ascertained against any other desired level, such as the "lowest observed tide," &c. For example, in the case of the Thames Estuary there are the following eight different levels:

H.W.O.S.T.
H.W.O.T.
H.W.O.N.T.
Trinity High Water Mark (12.5 O.D.).
L.W.O.S.T.
L.W.O.T.
L.W.O.N.T., and
The Port of London Authority datum line for soundings (−8 O.D.).

Although there would naturally be no confusion between high tide and low tide, there is ample room for misunderstandings as to their definition.

(c) *Current Observations.*—This section of marine survey work is required in cases where there is reason to suspect that the construction of new marine works may produce excessive scour, or cause silting and shoaling up in the immediate vicinity. Such surveys are also sometimes called for in dealing with claims cases in the law courts, and for the purpose of determining river or tidal discharges. They are likely to be of some importance in this country in the near future if tidal hydro-electric schemes emerge from their present somewhat visionary aspect into the field of practical politics, as is now the case in France.

Such observations naturally divide themselves into a study of:—

(1) Surface velocities.
(2) Sub-surface velocities.

The former may be of some importance when dealing with the berthing of vessels in a tideway, and the latter of importance in so far as they may affect the stability of marine work, or cause interference with the river or coastal *régime* in the vicinity.

(1) *Surface Velocities* may be estimated by observing the movements of any suitable form of float, either by following the latter in a boat with sextant observations which requires three pre-determined landmarks ashore—see Fig. 4—or, alternatively, simultaneous observations by theodolite at either end of an established shore base line which, as in the case of soundings, is to be preferred. For local surveys of the class under consideration, the necessity of using a sextant afloat is often urged, but this instrument, although useful for nautical observation, is of little value in ordinary marine survey work as practised by civil engineers. It is a common error to assume that a simple observation from a boat of the angle subtended by two fixed points ashore determines the position of the boat. The most elementary problems in geometry show this assumption to be incorrect, *e.g.*, in Fig. 5 are shown two alternative boat positions *a* and a^1 and there are, of course, many others giving the same sextant reading (*i.e.*, positions on the perimeter of the dotted circle).

Even with the minimum of three points ashore and two observed angles θ and ϕ as in Fig. 4, the reduction of each observed position to ordinate and abcissa for drawing-office purposes involves a considerable amount of calculation, and it is preferable, therefore, to adopt a base line ashore and follow the movements of the float or accompanying boat by simultaneous theodolite observations, generally on a pre-arranged time-table. The calculation of each observed position is then simple or equally straightforward if dealt with graphically on the drawing board.

The form of float for observing surface velocities must be such that it is practically awash, and, therefore, not subject to the influence of wind. A small mast must, however, be attached to the float to enable it to be seen, and a small black bulb at its head will be found to afford the best mark for locating. The float should be of large area and only a few inches in draught. One of the most satisfactory methods is to distribute several floats over a small area, and to smother the surface with light coloured dust such as powdered cork or brick dust, which remains buoyant for some time, and then to follow the floating "field" in a boat which, as an object, is easily picked up by the observers ashore. This method was tried in 1913 by one of the writers on the Burry Inlet, South Wales, with success.

(2) *Sub-surface Velocities.*—These observations, without doubt, present greater difficulties than any other section of marine survey work. They seldom can be dispensed with wherever it is considered there is any question whatever likely to arise in regard to possible scour or siltage which might be set up by the construction of new works.

One method is for a large submerged float to be suspended from a very small surface buoy, but the observations taken to the surface buoy are not really satisfactory because, no matter how small this buoy, its presence affects the free movement of the submerged float.

Another method, giving better results, is that shown in Fig. 6, where the surface and sub-surface floats have approximately the same mass and wetted surface. Surface observations are first taken with the upper float *alone*, the lower float or sinker is then attached by means of a light cable or line, and the average velocity of the two floats noted. By adding or subtracting the difference—as the case may be—in the observed velocities, the sub-surface velocity at the level of the lower float can be ascertained. There are some errors, however, in this method since, in the first place it cannot be assumed that the travel of the compound float will cover the same ground as that covered by the travel of the surface float alone and, where the differences in the surface and sub-surface velocities is marked, the exact level at which the lower float is travelling is doubtful.

Nevertheless the above methods are the really only practical ones for determining the travel of currents and their varying velocities at the same time.

The methods for measuring velocities alone, at any given fixed point, consist either of the employment of a current meter or a pressure tube.

The writers' experience of current meters has been unsatisfactory. The current meter in the first place is an expensive instrument and difficult to manage in an open tideway. In seems that its effective use is confined, more or less, to permanent station points in shallow water or in canal or irrigation systems. The calibration curve for such a meter must be taken before any series of observations are made, and there are a hundred and one possibilities of the meter gear sticking or jamming. The question of lubrication, and the class of oil used, also affect the instrument considerably. The use of pressure tubes would be satisfactory for torrential currents, but is little use for ordinary tidal speeds, as only a few inches difference in level is recorded for a current speed of several miles per hour and, except in absolutely still weather conditions, such small measurements are impossible to read accurately.

The writers have given some thought to the following method which, however, has, it is believed, never been tried, but is put forward for what it is worth.

It is well known that different materials respond to different scouring velocities, and an instrument could presumably be devised by obtaining a number of tubes partly filled with different materials graded from very fine sand up to small pebbles, whose scouring velocities had been previously obtained by laboratory experiment. This instrument could be moored to a boat at anchor, and held at the other end by a down-stream float or buoy, riding at a known distance from the boat as shown in diagram, Fig. 7. The depth would definitely be known and the instrument would take up a true alignment with the direction of flow. The submerged tubes would be opened at both ends by a snatch halyard, or an electric device, and after a few minutes closed again. The instrument on being raised to the surface would then show some of the tubes scoured out and others with material still remaining in, according to the scouring velocity of the current which, within narrow limits, could then be definitely ascertained.

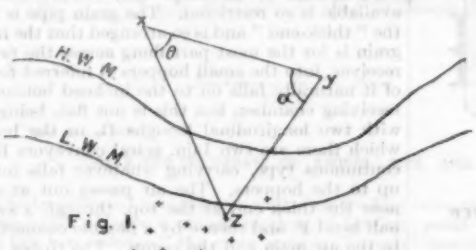


Fig. 1.

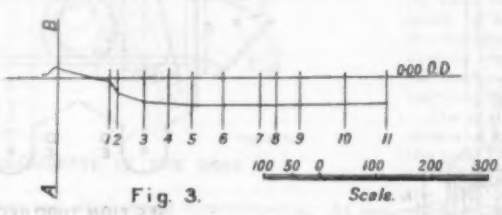


Fig. 3.

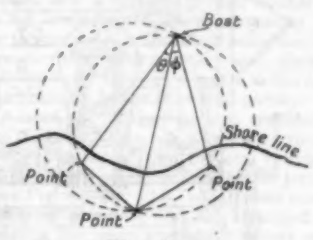


Fig. 4.

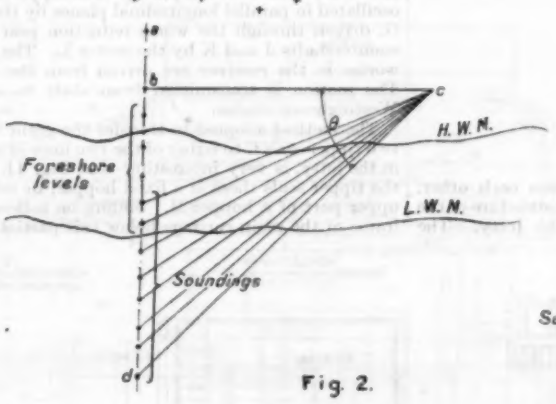


Fig. 2.

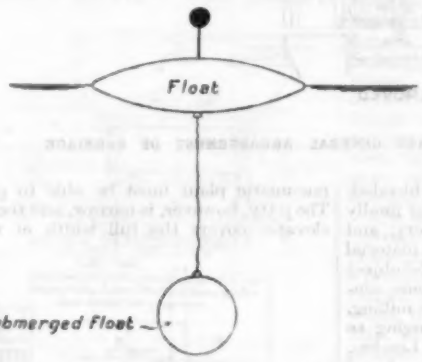


Fig. 6.

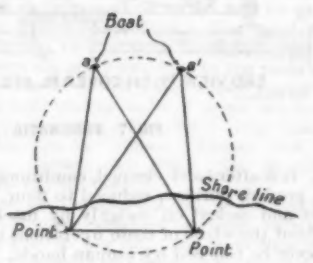


Fig. 5.

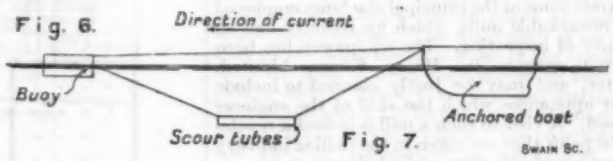


Fig. 7.

"THE ENGINEER" SWAIN SC.

Table of Soundings in Horseshoe Bay.

	No.	Time. h.	Time. m.	Angle.	Sounding. Feet.	Correction. Feet.	Reduced level. Ft., O.D.	Distance out from A.B. Feet.
Line I.A.	1	10	8	13.20	2.5	+ 4.3	− 6.8	92
	2	10	13	15.20	25.7	+ 4.0	− 29.7	106
	3	10	15	21.20	37.5	+ 4.0	− 41.5	150
	4	10	17	26.20	39.0	+ 3.8	− 42.8	192
	5	10	19	31.0	42.0	+ 3.7	− 45.7	234
	6	10	20	36.40	43.0	+ 3.6	− 46.6	287
	7	10	22	42.0	42.0	+ 3.5	− 45.5	352
	8	10	24	47.40	44.0	+ 3.4	− 47.4	426
	9	10	26	52.20	42.0	+ 3.3	− 45.3	505
	10	10	26	52.0	44.7	+ 3.3	− 48.0	502
	11	10	28	55.40	45.0	+ 3.2	− 48.2	571

A Modern Flour Mill.

No I.

FEW food products presented so many mechanical difficulties in preparation in the past as pure white flour, yet it is doubtful whether any other manufacturing process has been brought to a higher degree of efficiency at the present time than that employed in a modern flour mill. The raw material in the form of wheat is received from the ship, barge or wagon, and is discharged and stored by mechanical means. It is afterwards cleaned, conditioned, blended, milled, graded, purified, reduced to flour, and finally weighed and sacked off entirely by machinery, and throughout the whole of these operations the material need never be touched by human hands. The object of this series of articles is to describe in some considerable detail the complete system of flour milling, as practised at the Millennium Mills, belonging to W. Vernon and Sons, Limited, Victoria Dock, London, and illustrate some of the principal machines employed in these remarkable mills, which we recently had an opportunity of inspecting. The equipment has been carried out entirely by Henry Simon, Limited, Manchester, and may be justly claimed to include the latest appliances which the skill of the engineer has devised. A visit to such a mill is indeed a revelation of the pains that are taken in the milling industry to produce a perfectly pure and wholesome food.

Before commencing a description of the new mills, it may be recalled that the original Millennium Mills, erected at Victoria Dock, London, in 1905, had a total capacity of 100 sacks—each containing 280 lb.—of flour per hour, in two units, the whole of the grain cleaning and milling machinery being supplied by Henry Simon, Limited. As a result of the great explosion at Brunner Mond and Co.'s high explosive refinery at Silvertown, on January 19th, 1917, the screen room and mills were destroyed although the silo remained undamaged, and Messrs. Vernon decided to erect on the old site an entirely new mill and screen room, equipped with all the most modern machinery obtainable. The order for the machinery equipment was again placed with Henry Simon, Limited, and it is chiefly with the appliances supplied by this firm that this article deals.

The reconstructed mill buildings, views of which are given in Figs. 1 and 2, page 612, are very similar to those which they replace. They are of reinforced concrete and being situated on the Victoria Dock, can receive cargoes of wheat direct from the ships into the silos. Extensive railway sidings are provided alongside the warehouse, so that the sacks of flour can be delivered direct into railway trucks by means of shoots. Facilities have also been provided for loading the sacks on to the firm's steam wagons.

Ocean-going vessels are discharged at a jetty alongside the mill premises at the rate of 200 tons per hour, by means of a travelling bucket elevator made by Spencer and Co., Limited, Melksham, and an auxiliary pneumatic grain discharging plant recently supplied by Henry Simon, Limited. The bucket elevator is first plunged into each hold to remove as much wheat as will readily flow to it, and the remainder is then discharged by the pneumatic plant—Fig. 5—whilst the bucket elevator is at work on another hold. The pneumatic plant is a recent addition to the equipment, and is of special design to meet the peculiar conditions imposed by the circumstances of the case. It will readily be understood that a vessel cannot be discharged by taking the holds in numerical sequence from end to end. The trim of the vessel would be too gravely impaired by such a process. Since the bucket elevator must take the holds in such an order as will not too gravely upset the trim of the vessel, and may be for the same reason compelled to pass from one hold to another before the one is finished and then return, it is obvious that the bucket elevator and the pneumatic plant must be able to pass each other. The jetty, however, is narrow, and the structure of the elevator covers the full width of the jetty. The walking space below the structure is only 8ft. high and about 10ft. wide.

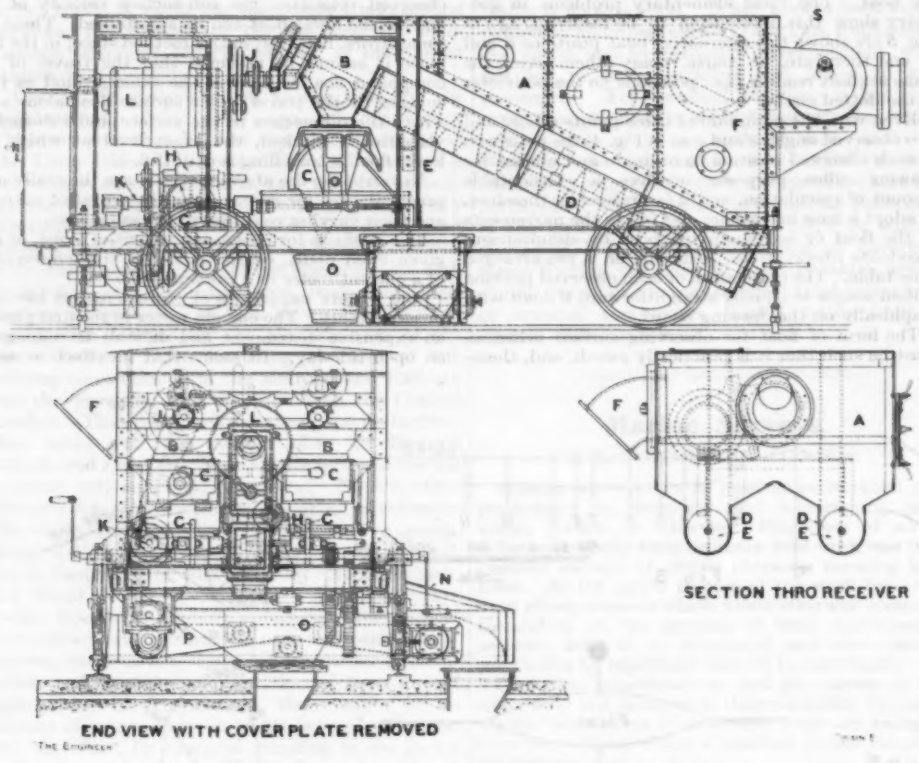


FIG. 7—PNEUMATIC PLANT—GENERAL ARRANGEMENT OF CARRIAGE

The problem was to design a pneumatic ship discharging plant capable of handling 70 tons of wheat per hour which would pass through this small opening. Also, since the passing of the two elevators might occur two or three times in one day, the rigging and removing of the suction pipes must be a quick operation, and the handling of the pipes in the hold must be facilitated as much as possible to enable the plant to be kept in operation as constantly as possible when in use. The problem was further complicated by the fact that the openings in the floor of the jetty, through which the wheat has to be shot on to the belt conveyors below, are in staggered positions along two parallel lines instead of being all in one line, as is more common. These difficulties have been overcome with considerable ingenuity. The resulting machine, with its pipes stowed ready to pass below the elevator is shown in Fig. 3, and actually beneath the elevator in Fig. 4 and it will be seen that it is hardly recognisable as belonging to the same order of machine as other pneumatic plants.

The vacuum pump is separated from the travelling plant and is placed in a small house on the quay, opposite the jetty, and communicates with the travelling receiver, &c., by means of a range of air piping along the jetty, having connecting branches at intervals of 18ft. The dust collector, of the cyclone type, is also separated, being placed in an elevator tower at the end of the jetty. The travelling plant itself, therefore, comprises the receiver, the discharging mechanism—see Fig. 7—and the grain suction pipes. The receiver A, instead of the usual cylindrical chamber, is a wedge-shaped chamber with horizontal top, vertical "thick-end" and inclined bottom. The "thin-end" communicates with a small double hopper B, feeding into two of Henry Simon's standard tipper seals C. Two small seals are used instead of one large one, because the height available is so restricted. The grain pipe is led into the "thick-end" and is so arranged that the incoming grain is for the most part flung across the top of the receiver, into the small hoppers B referred to. Some of it naturally falls on to the inclined bottom of the receiving chamber, but this is not flat, being formed with two longitudinal troughs D, in the bottom of which there are two 14in. spiral conveyors E, of the continuous type, carrying whatever falls into them up to the hoppers. The air passes out at one side near the thick end at the top, through a swivelling half bend F, and thence by a flexible connecting pipe to the air main and the pump. The tipper seals are oscillated in parallel longitudinal planes by the cranks G, driven through the worm reduction gear H, and countershafts J and K by the motor L. The inclined worms in the receiver are driven from the shaft J. The motion is transmitted from shaft to shaft by Westinghouse chains.

The method adopted to transfer the grain from the two tipper seals C to either of the two lines of openings in the jetty, is very interesting—see Fig. 11. Below the tipper seals there is a fixed hopper, or rather the upper part of a hopper M. Sliding on rollers on the frame of the main carriage below this partial hopper, there is a carriage N carrying side by side, first the lower part O of the hopper M, arranged to deliver to the central line of openings and secondly a short transverse band conveyor P, for delivering to the line of openings at one side. Either of these can be pushed under the part hopper M as required. It will be seen that the grain has to be fed on to this conveyor from

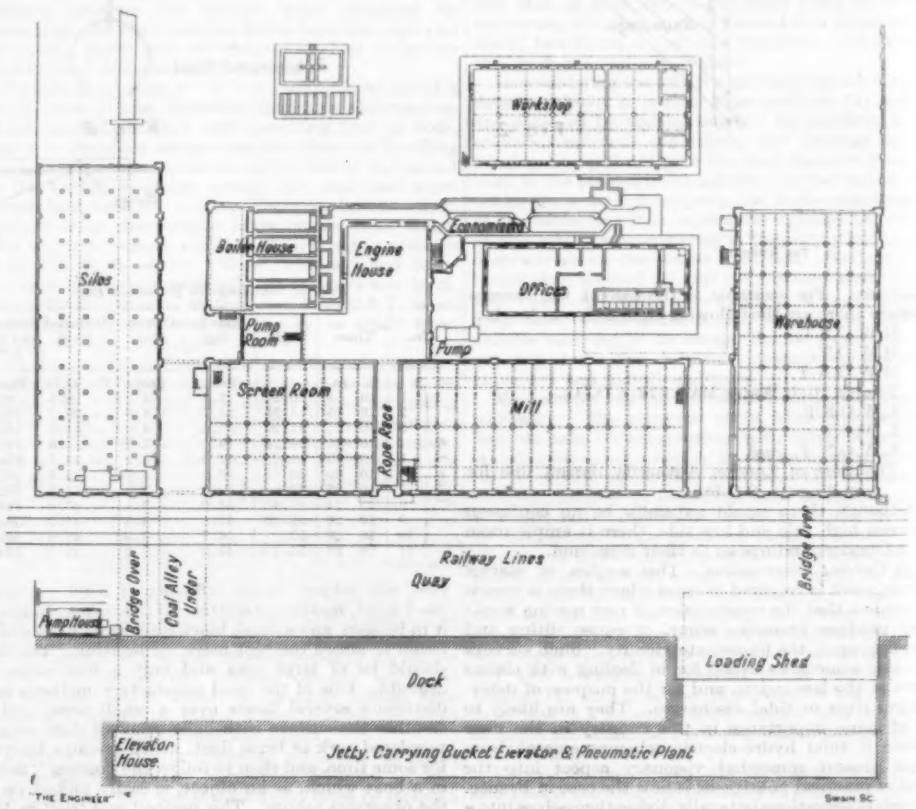
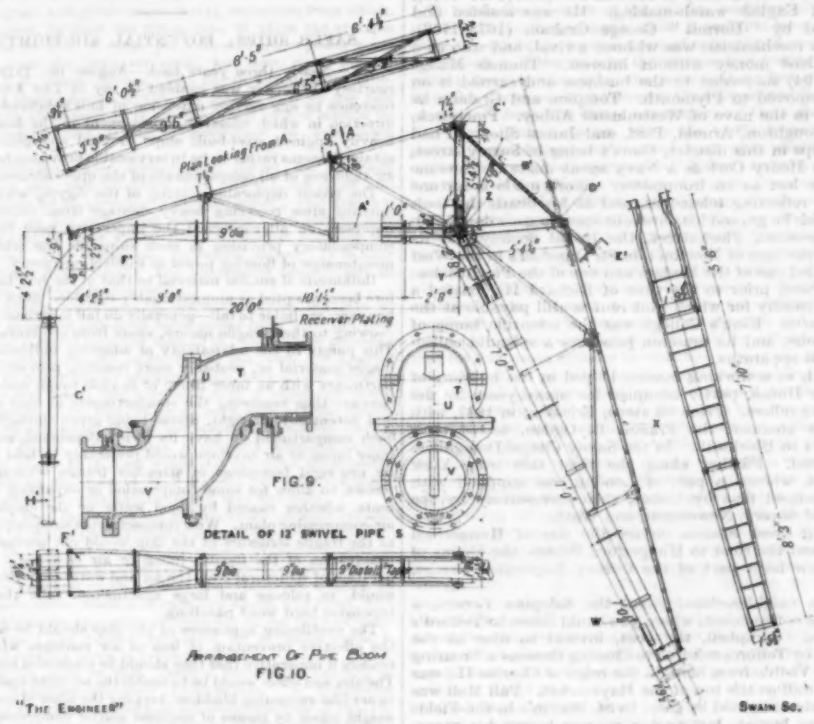


FIG. 8—PLAN OF MILL, QUAY, DOCK AND JETTY

each of the four tipper doors, all of which are moving over an arc of a circle as they discharge, and there is no height available to enable these four falling back or forward, the driving pulley slides on its shaft to which it is clutched in the working position.

The grain pipe arrangements are as ingenious as



FIGS. 9 AND 10—DETAIL OF SWIVEL PIPE AND ARRANGEMENT OF PIPE BOOM

streams to be collected into one stream before feeding on to the band. Hence a unique method of feeding the belt has been adopted, the grain passing through the receiver and discharging arrangements. At the point where the pipe is connected to the receiver, there is a swan-neck S—see Fig. 9—which permits of

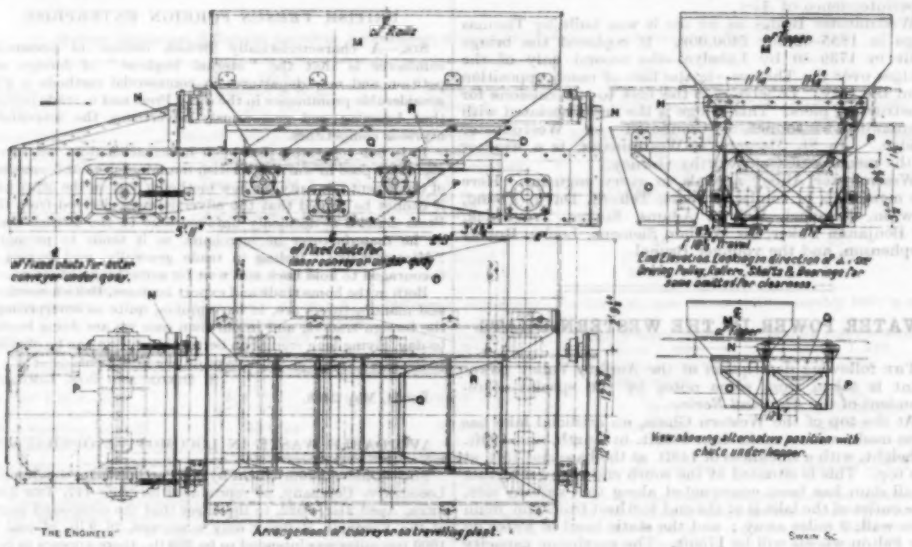

Rails
Tipper
Fixed chute for outer conveyor under quay.
Fixed chute for inner conveyor under quay
End Elevation Looking in direction of Arrow Showing Pulley, Rollers, Shafts & Bearings (for same omitted for clearness.
View showing alternative position with chute under hopper.
Arrangement of conveyor on travelling plant.
"THE ENGINEER"
SWAIN SC.

FIG. 11—ARRANGEMENT OF CONVEYOR ON TRAVELLING PLANT

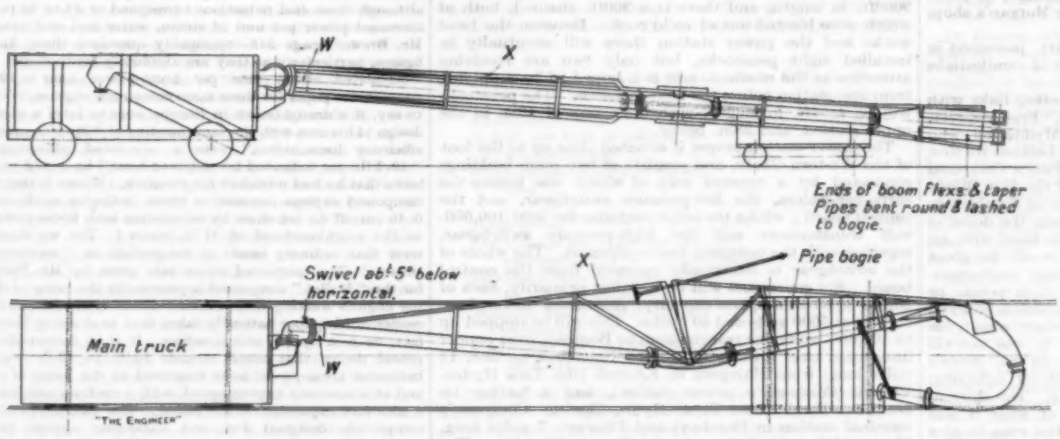
the long box Q, fitted with a series of inclined guide vanes R, deflecting the four streams into the direction of the travel of the band. This entirely novel arrangement works quite satisfactorily, even when the box Q is full of grain. The conveyor is driven from the motor shaft K—see Fig. 7—by a Westinghouse-Morse transmission, and as the conveyor carriage is pushed swivelling movements about the axes T, U and V. To the outer swivelling flange V there is bolted the 12in. pipe W,—Figs. 10 and 12—to which is secured the triangular steel bracing X. The outer end of this pipe is connected by longitudinal channels Y, and bearing blocks to the hinge pins Z, and is similarly braced. The pipes W and A^1 are connected by a short length of flexible pipe passing between the hinge pins, and the free corners of the bracings are connected together with the long square-threaded screw B^1, having a swivelling nut at C^1 and swivelling thrust bearing at D^1. Thus the pipes W and A^1 with their bracings and screw, form one braced boom-structure capable of being bent at the hinge points Z through an angle of more than 90 deg., by turning the hand-wheel E^1. The pipe A^1 branches to two bends of rectangular section F^1 with permanently attached 6in. flexible pipes G^1, and connectors H^1 for coupling up additional portable and flexible piping. When stowed, the boom lies on its side, with its outer end resting on a trolley running on the same rails as the receiver carriage. The swivel lies with its axis U—see Fig. 9—a few degrees below horizontal, and the main pipe is bent slightly backwards. To bring it into the working position and to support it, and to manipulate it when working, the ship's derricks are employed. The boom is lifted by two shackles attached to the outer part, and as it lifts it gradually turns over on the axis T, and the boom can then be slewed round into the working position over the hatch, the carriage being travelled forward at the same time by means of hand gear provided for the purpose. The boom is straightened by means of the screw B^1—Fig. 10—and if necessary, it is bent so as to clear the ship's bulwarks. It will be seen that when the boom is supported by the ship's tackle, as shown in the illustration—Fig. 5—there is very little load on the screw B^1, and it is easily turned.

The vacuum pump of Messrs. Simon's special design, is of the single-cylinder type, 43/4in. diameter by 14in. strike, and is driven through double helical gears by a 90 horse-power motor, running at 700 revolutions per minute. The dust collector, of the cyclone type, is fitted with a rotary seal, discharging the dust continuously through a spout to the elevator carrying the grain up to the overhead gantry.

The grain from the subway belts is transferred by means of an elevator housed in a tower at the end of the jetty, and then transferred to band conveyors in an overhead gantry, which connects the jetty with the silo—see Fig. 8. The silos, which were erected in 1905, are of ferro-concrete, and are arranged in two sections, one for the main storage of wheat received from ships or barges, and the other for the storage of wheat about to be passed on to the mill for grinding, termed the intermediate bins. The total holding capacity for the two sections is 50,000 quarters of wheat. There are sixty-two bins in the main storage section and sixteen in the intermediate section. The former bins hold twenty sacks of wheat per foot, and the latter sixteen sacks. The depth of the bins in the main section are as follows:—Centre row, 90ft.; next, 85ft.; outside row, 80ft. The intermediate bins are 54ft. to 58ft. deep.

The wheat, as it enters the silo, is checked on two "Avery" Automatic weighing machines, each capable of weighing 3000 lb. per tip. The grain then receives a preliminary cleaning on screening sieves, and is then carried by bucket elevators to the top of the silo, where it is delivered by means of band conveyors, 22in. wide, to any desired bin in the main storage section. There are two conveyors above the bins and two bands below the bin outlet hoppers, one of which is reversible. The machinery is so arranged that by the adjustment of slides in the spouts to and from the bins, it is an easy matter to take in, turn over or deliver wheat to or from any particular bin. Provision is also made for the intake of wheat brought to the mill in railway wagons. The equipment of the silo and the installation of mechanical handling appliances in the warehouse was carried out by Spencer and Co., Limited, Melksham.

THERE is an enormous body of graphitic ore close to the surface, at Tulimani Hill, Machakos District, Kenya. It occurs apparently in a seam whose greatest width is 110ft.,



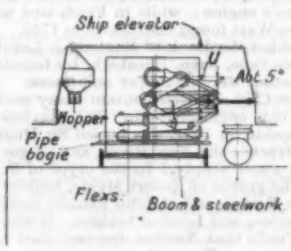


FIG. 12—PIPE BOOM IN STOWED POSITION

the present working face being 75ft. across; at present the ore is quarried, but bores have been put down 75ft. without reaching the bottom. A quantity of ore has been used successfully for making refractory bricks locally.

An Engineer in Old London.

By Engineer-Commander EDGAR C. SMITH, O.B.E., R.N.

SOUVENIR OF THE SUMMER MEETING OF THE NEWCOMEN SOCIETY IN LONDON, 1922.

FOR the engineer with a love of the past, London is full of interest, for just as a devotee can still follow, through the busy streets, in the footsteps of Lamb and Johnson and Dickens, so amidst all the changes of the centuries can be found spots made memorable by the labours of Graham and Ramsden, Newcomen, Smeaton and Watt. Only some of these spots will be indicated here, because for the present purposes we confine ourselves, perforce, to a line running east and west from Tower to Abbey, and passing by the Bank and St. Paul's to Fleet-street and the Strand.

The Tower is the centre of a group of institutions dating back many centuries. The Tower itself was the National Armoury and Munitions Factory, so to speak, from the fourteenth century onwards; here, also, was the site of the Mint. On Tower-hill was the legalised mart for the sale of guns, and in the Minories flourished many makers of small arms. In the chapel of the Tower lies Sir Jonas Moore, to whom we owe the Greenwich Observatory. He was Surveyor of the Ordnance, and being sixty-two years of age when he died, sixty-two guns were fired at his funeral. It was as his guest that Flamstead stayed a while in the Tower, and made observations from the south-east turret of the White Tower.

St. Katherine's Docks, built by Telford in 1825–28, occupy the site of the hospital of St. Katherine, founded in 1148 by Queen Matilda. William, Viscount Brouncker, mathematician and first President of the Royal Society, after its incorporation, was a master of this hospital, and was buried in its chapel. Barlow's subway, 1869, now disused, from Tower-hill across the Thames to Tooley-street, readily escapes notice. The existing Mint, close by, is associated as regards coining machinery with the names of Boulton and Maudslay, and with Sir John Herschel and Thomas Graham, the chemist, who were Masters.

The Corporation of the Trinity House, near by, now responsible for our lighthouse engineering, has a story going back to the time of Henry VIII., when its home was at Deptford-le-Strand. James Walker, second President of the Institution of Civil Engineers, and Sir James Douglass were the master lighthouse builders of last century, while Lord Rayleigh, Tyndall and Faraday were associated, as scientific advisers, with the beneficent work of Trinity House.

Passing into Fenchurch-street, it should be noted that the station here was the terminus of the Blackwall Railway, worked by stationary engines and rope. Running out of Fenchurch-street is London-street, where Watt dated his letters when defending his patents. Here is also the condemned church of St. Catherine Coleman, in which Lord Mayor Sir Henry Billingsley was buried in 1606; thirty-six years earlier he had published the first English translation of Euclid's Elements.

In Aldgate, in 1831, died William Symington, the pioneer of marine engineering. He was buried in St. Botolph's Church, and a few years ago a tablet was placed there to his memory. Turning off Houndsditch was Woolpack-alley, where, so early as 1705, you could buy Walcot's plant "for making salt water fresh," for use aboard ship. Another turning leads to St. Mary Axe, whence, from No. 42, in 1828, Trevithick and his friend Gerard both wrote letters; it was Gerard who had saved Trevithick from drowning while in South America. Not far from St. Mary Axe stands the famous St. Helen's Church—the Westminster Abbey of the City. Hereabouts was the centre of British science in the seventeenth century. In the church lies Robert Hooke, of Hooke's law, and here is found the tomb of Sir Thomas Gresham. Gresham's house covered a site between Bishopsgate-street and Old Broad-street, and after his wife's death it became Gresham College. It sheltered many Gresham professors, and for a long time provided a house for the Royal Society. Hooke lived in the College for forty years, and Denis Papin was for a time his assistant. Another Gresham professor—Gunter, of Gunter's chain fame—was buried in the church of St. Peter le Poer, in Old Broad-street. It was in an office in this street, in 1856, that Bright and Whitehouse demonstrated to Morse the possibility of signalling rapidly through 2000 miles of wire. Dividing great banking houses, running from Threadneedle-street to Lombard-street, are Finch-lane and Birchin-lane. In 1716, at the Sword Blade Coffee Tavern, in Birchin-lane, you could learn all about the advantages of Newcomen's engine; while in Finch-lane was Morgan's shop, where Watt found instruction in 1755.

Behind the Bank of England is Lothbury, possessed in Stow's time, *temp.* Elizabeth, by founders of candlesticks and other ware in copper and latten.

The City churches contain many connecting links with the old engineers. In St. Matthew's, Friday-street, Cheapside, in 1631, was buried Sir Hugh Myddelton, who constructed the New River, and so gave London its first good water supply. In the crypt of St. Paul's Cathedral are the graves of Robert Mylne, builder of the first Blackfriars Bridge, and of John Rennie, designer of Southwark, Waterloo, and London bridges. It was from the dome of St. Paul's that Newton dropped glass balls filled with air or mercury. To an electrician, St. Paul's recalls the great controversy that took place over lightning conductors. The question was, should conductors end in points or knobs, and from a scientific question it became a political one. Franklin had told the Royal Society about his experiments, and had been laughed at. It was not till 1764, when Wren's beautiful campanile on St. Bride's Church, Fleet-street, was badly damaged by lightning, that the conductor was taken up seriously. The spire of St. Bride's as seen to-day is 8ft. short of what it was then. In this church lies Dr. Wills, the first man to give the true explanation of dew.

In coming to St. Bride's from Ludgate-hill, we cross the Fleet River, now a sewer, but formerly navigable above this point, as is indicated by the name "Sea Coal-lane." Near the junction of the Fleet with the Thames was the site of one of the earliest of the London gasworks. Near St. Bride's Church, in Salisbury-court, was Savery's "workhouse," where, in 1702, his engine could be seen at work "every week-day from 3 to 6 in the afternoon."

Fleet-street and the Strand recall many of the old instrument makers. At No. 67, Fleet-street, at the corner of Water-lane, was the shop of Thomas Tompion (1639–1713), father of English watch-making. He was assisted and succeeded by "Hermit" George Graham (1675–1752), who as a mechanician was without a rival, and who as a Quaker lent money without interest. Thomas Mudge (1715–1794) succeeded to the business and carried it on till he removed to Plymouth. Tompion and Graham lie together in the nave of Westminster Abbey. Pinchbeck, Cary, Troughton, Arnold, Bird, and James Short all had their shops in this district, Short's being in Surrey-street, in which Henry Cort as a Navy agent made the fortune which he lost as an ironmaster. Short made a fortune with his reflecting telescopes, and at his death the tools with which he ground his parabolic specula were destroyed. In Crane-court, Fleet-street, the Royal Society had its home in the time of Newton; in St. Dunstan's in the West were buried one of the Mudges and one of the Pinchbecks.

Near here, prior to the time of Richard II., existed a forge or smithy for which quit rent is still payable at the Law Courts. King's College was the scientific home of Wheatstone, and its museum possesses a splendid collection of his apparatus.

Telford, as a working mason, helped in the building of Somerset House, partly occupied for many years by the Admiralty offices. From its steps, Ericsson, in 1837, with his screw steamer, the Francis B. Ogden, towed their Lordships to Blackwall. In the Savoy Chapel Desaguliers was buried. Further along the river side were York Buildings, whence a part of London was supplied with water pumped first by horses, then successively by the engines of Savery, Newcomen, and Watt.

Charing Cross Station covers the site of Hungerford Market and the road to Hungerford Bridge, the chains of which now form part of the Clifton Suspension Bridge, Bristol.

In this neighbourhood stood the Salopian Tavern, a high-class coffee house, where you could listen to Telford's anecdotes. Campbell, the poet, invited to dine at the Salopian by Telford, referred to Charing Cross as a "roaring vortex." Visible from here, in the reign of Charles II., was the windmill at the top of the Haymarket. Pall Mall was the first street lighted by gas. In St. Martin's-in-the-Fields Boyle was buried, but to-day no one knows his grave. Joseph Huddart, who made a fortune by his rope-making machine, also lies there. Smeaton, Ramsden, John Hunter, and others used to foregather at Slaughter's Coffee House in St. Martin's-lane. Leicester-square and St. Martin's-street recall the homes of Newton. The standards of length in Trafalgar-square were placed there in 1876 under the superintendence of Airy.

Westminster Bridge as we see it was built by Thomas Page in 1855–62 for £400,000. It replaced the bridge built in 1739–50 by Labelye—the second only of the bridges over the Thames—in the face of much opposition from the City. Labelye was the first to use caissons for constructing piers. This bridge is the one associated with Wordsworth's sonnet, "Composed on Westminster Bridge." In St. Margaret's, Westminster, is a window to the memory of Goldsworthy Gurney.

Westminster Abbey appeals to every engineer. Here are memorials or tombs to Watt, Telford, Davy, Young, Newton, Herschel, Kelvin, Adams, Stokes, Trevithick, Sir Benjamin Baker, Sir William Siemens, Locke, Robert Stephenson, and the younger Brunel.

WATER POWER IN THE WESTERN GHATS.

THE following description of the Andhra Valley power plant is taken from some notes by the special correspondent of the *Electrical Review*.

At the top of the Western Ghats, an artificial lake has been made, with a main dam 1850ft. in length, and 190ft. in height, with a thickness of 148ft. at the base and 15ft. at the top. This is situated at the south end; and a further small dam has been constructed along the western side. The outlet of the lake is at the end furthest from the main dam wall, 9 miles away; and the static head of water on the Pelton wheels will be 1750ft. The maximum capacity of the lake is 14,484 million cubic feet, and the catchment area is roughly 48 square miles. The average rainfall in the catchment area is 105in. per annum, which falls wholly during the few months of the rainy season. At high-flood level, the lake will have an area of 125 square miles, and will vary in depth from 75ft. at the tunnel entrance to 200ft. at the main dam. The tunnel is about 9000ft. in length, and there is a 300ft. channel, both of which were blasted out of solid rock. Between the head works and the power station there will eventually be installed eight penstocks, but only two are receiving attention at the moment, and it is hoped to be supplying from this station before the next monsoon. The penstocks will be 4800ft. in length, with diameters of 42in. in the upper section, and 38in. below.

The power station proper is situated close up to the foot of the Western Ghats, and consists of two main buildings connected by a covered way, of which one houses the turbo-generators, the low-pressure switchgear, and the control board; whilst the other contains the 5000/100,000-volt transformers and the high-pressure switchgear, together with the outgoing line equipment. The whole of the switchgear is electrically operated from the control board. Six generators will be installed primarily, each of 10,000 kilovolt-ampères capacity, generating three-phase current at 5000 volts and 50 cycles. This will be stepped up to 100,000 volts for transmission to Bombay, over copper lines upon steel tower structures. There is a tie line, 17 miles long, from Bhivpuri to Khopoli (the Tata Hydro-Electric Company's power station), and a further tie between Parel (the Tata Hydro-Electric Company's terminal station in Bombay) and Dharavi, 7 miles long. The total length of transmission line is 80 miles. The incoming transmission line energy will be transformed down to 22,000 volts at the Dharavi receiving station, and there distributed to consumers' sub-stations, where there will be a further reduction to 2200 volts, 400 volts, and 230 volts.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

SAFER SHIPS: POTENTIAL AIR-TIGHTNESS.

SIR,—Nearly three years back—August 1st, 1919—by your courtesy the writer was enabled to say in THE ENGINEER, in reference to any further extension of hull subdivision: "The direction in which effective improvement in the floatability of heavily engined steel-built ships in vital emergency may be attained, seems rather to be in serviceable provision for potential air-tightness of all compartments of the upper structure."

The recent deplorable sinking of the Egypt, within twenty minutes after receiving heavy damage from collision, again impresses on all concerned the imperative need for effective compensatory provision in such ships for the retention and maintenance of floating power in sudden emergency.

Bulkheads of similar material to that of the hull have heretofore been accepted as unquestionably suitable. Such bulkheads, however, are liable to fail—generally do fail in serious emergency—owing to their fragile nature, apart from structural strength. This points to the advisability of adopting bulkheads of non-fragile material or, probably more feasible, providing all compartments with an inner lining of flexible tough material—say, canvas—thus rendering the compartments at once water-tight and potentially air-tight, access being given through air locks, each compartment to have its own independent access. The inner lining or air envelope would preferably be held in position by non-rigid fastenings or stretcher frames without nails or screws, to allow for some compression or expansion of air contents, whether caused by flood water or the employment of air-compressing plant. With compartments so equipped, damage to the fragile structure of the ship would not necessarily cause penetration of the flexible lining or air envelope. As to the question of structural cost, the air and water-tight flexible lining would, in saloons and large apartments, take the place of expensive hard wood panelling.

The ventilating appliances of the ship should be adapted for the effective prevention of loss of air contents when danger renders it imperative that they should be controlled and retained. The aim and effect would be to enable the air-tight compartments to act like swimming bladders, keeping the mass of non-buoyant weight afloat by means of confined and/or compressed air.

In a ship so designed and fitted, injury to one compartment should not easily affect another, and the probability of a large majority remaining intact and effective against flooding danger, in spite of heavy local damage, should be very great.

London, May 26th. ROBERT MOORE STEELE

BRITISH *VERSUS* FOREIGN ENTERPRISE.

SIR,—A characteristically British feature of present-day commerce is that the "eternal bugbear" of foreign competition and new departures in commercial methods is given considerable prominence in the daily Press and in trade journals, thus booming and gratuitously advertising the activities of overseas competitors.

It is not suggested that such information does not serve a useful purpose in warning British manufacturers and merchants of the urgent necessity for new methods, but, on the other hand, it cannot be denied that the advertisement derived from these Press articles is decidedly unfavourable to the British trader, be he manufacturer or merchant, as it tends to promote a "Micawber-like" feeling in trade generally, and buyers are encouraged to hold back and wait for something to turn up.

Both in the home trade and export business, British merchants and manufacturers are, in our opinion, quite as enterprising as the foreign traders, and in our own case we are doing business to-day, giving long credits on better terms than can be obtained, so far as we know, in America or on the Continent.

S. DIXON AND SON, LIMITED.

Leeds, May 24th.

AVOIDABLE WASTE IN LOCOMOTIVE OPERATION.

SIR,—Unless the statement by Mr. Partington, of the American Locomotive Company, as reproduced on page 447, THE ENGINEER, April 21st, 1922, to the effect that the compound engines of the Virginian Railway only consumed 26.9 lb. of coal per 1000 ton-miles was intended to be 269 lb., there appears to be no feasible explanation. Compound engines in the daily service of the continental trunk lines show a reduced coal consumption of from 25 to 42 per cent., the variations being determined exclusively by the rates of expansion variously employed relatively to those of new superheated steam locomotives of equal or greater weight; but in this there is nothing abnormal or that is not pre-determined by the design in the drawing-office, although these coal reductions correspond to 45 to 60 per cent. increased power per unit of steam, water and coal consumed. Mr. Brewer—page 548—reasonably questions these American figures, particularly as they are absolutely contradicted by the "calculated steam rate per horse-power hour = 19.7 lb." given in the paper for these same compound engines. Needless to say, if a draughtsman in Europe were to label a compound design of his own with the same heading of "Modern maximum-efficiency locomotives," over a calculated consumption of "19.7 lb. per indicated horse-power hour," he would promptly learn that he had mistaken his vocation. Where is the modern compound express locomotive whose indicator cards made at 0.40 cut-off do not show by calculation each horse-power hour in the neighbourhood of 11 lb. water? Yet we should not term that ordinary result in compounds as "maximum efficiency." The calculated steam rate given by Mr. Partington for the "Mallet" compound is practically the same as that for the engines wasting their exhaust direct to the air, and every reader of his paper naturally takes that as showing there is, in fact, no gain by the compounding. It is an inexcusable compound design that much exceeds 10 lb. to 12 lb. water per indicated horse-power hour measured at the point of cut-off, and at almost any express speed, with a medium admission and a nine-fold expansion of the steam. This refers, of course, to compounds designed for, and indicating almost perfectly balanced piston loads, in both the small and the large cylinders alike, at all the varying speeds from 40 to 340 revolutions per minute, and not by any means to the semi-compound, semi-simple locomotives of the French and Italian railways, and of which similar "lame duck hoppers" appear to have been unpleasantly experienced in Russia.

It must be understood that the extraordinarily low figures

per indicated horse-power hour sometimes given from the Altoona roller tests and elsewhere by locomotives exhausting their steam direct to the air, are attained at only certain particular speeds (170 to 180 revolutions per minute for goods or express) and with one particular rate of cut-off (30 and 40 per cent. for express and goods respectively), variations from which, above or below, increase the steam rate, of which the extreme minimum of 15.4 lb. of water per indicated horse-power hour, calculated from the indicator cards, has been given for the 160-ton P.R.R. goods engines, Class Iis, as tested in the laboratory, and working with 250 lb. per square inch on one side of the pistons and about 18 lb. on the other, with a tension on piston segments and frictional resistances in accordance therewith.

From available water consumption curves the ordinary draughtsman can, without delay, pick out the one speed and cut-off position which gives this minimum result; and thus it is also selected as the calculated rate claimed for certain new engines exhausting their steam direct to the air built for the Czecho-Slovak, late Bohemian, Railways, namely 16 lb. per indicated horse-power hour. The uninitiated become lost in wonderment at this splendid result.

Under varying conditions in ordinary service the rate of feed water gross per indicated horse-power hour with the very same engines is rarely ever less than 19 lb., while under precisely similar conditions on the same roads, but with yet heavier trains and at rather higher average speeds, locomotives working with a two and a-half fold increased rate of expansion (compound) average 13 lb. feed water at very high express speeds and on heavy gradients. At the low speeds of American freight trains the "Mallet" compounds, if properly designed, should not average above 13 lb. feed water per indicated horse-power hour. Even so, the rate of 26.9 lb. coal per 1000 ton-miles is inexplicable, even with anthracite—if that was used.

The doubt thus thrown on the figures under mention entitles one to wish to see the indicator cards taken from these "Mallet" engines at 26.9 lb. coal per 1000 ton miles. Without co-ordination of the results from all steam locomotives—and their results, as given by indicator cards all over the world, are as alike as machine-made nails—there is always this chaos, and loose, wild series of statements appearing periodically in the popular engineering Press. The control permitted by indicator cards is denied, and lengthy prose is given instead.

For example, here we find, under a pretentious heading of "Modern Maximum-efficiency Locomotives," a compound engine using superheated steam at the enormous rate of 19.7 lb. per horse-power hour, when, so long as thirty-one years ago, saturated steam locomotives of 156 lb. per square inch boiler pressure were working fast stopping trains in a Russian winter season—not in a laboratory—with a gross feed water consumption of 19.1 lb. per indicated horse-power hour and 2.1 lb. of coal per indicated horse-power hour, yet with no pretentious headings or loud announcements of it in the Press. These were due to improved minor details progressively introduced under his *regime*. For "window decoration," the engineering Press contrives to attribute the economy of all those little but slow improvements exclusively to the use of some particular patented invention.

To settle the question of the relative economy of the compound system—that economy which is sealed in invariable and exact *pro rata* to the increased rate of expansion it economically permits—it is better to take the comparative results from the same railway services using the same coal, as here translated from the *Chronique* of the French Civil Engineers' Society, in an abstract from *The Times* newspaper:—"On a part of the New York Central system, where the traffic is mainly coal, sixty 'Consolidation' locomotives were sent elsewhere and replaced by twenty-six compounds ('Mallet' system), and with less than half the previous number of engines, these compounds operated the whole traffic at higher average speeds and with a reduced coal consumption per ton-mile by 35 per cent." This is, of course, equal to a power increase, per pound of coal burnt, of 54 per cent., and is, therefore, as presumably most persons know, a common average in any compound engines, whether "Mallet" two-cylinder expresses or "Mallet" four-cylinder goods. If such a result were not realised, serious complaint against the responsible draughtsmen and engineers would be justified, although if they could in self-defence show that the live steam cylinder or cylinders were of the same total volume as those provided for the engines exhausting direct to the air, and therefore able, as recommended by the P.L.M. steam experts in 1890, to absorb the fullest boiler capacity, and that the distribution, as shown by the pressure indicator, was reasonably perfect, then the traffic department should be approached for an explanation of why the engines were being so enormously overloaded that the rate of expansion had to be reduced near to that of ordinary engines, and in thus wiping out to some extent the great economy which is exclusively dependent on a nearly trebled rate of expansion. The gain is solely and purely geometrical, and is so easily measured on the indicator cards as to be within the competence of an elementary school child to explain, although Mr. Herdner, of the Midi Railways, whose opposition to the system is now notorious, has indeed said that it is not a geometrical economy*; and the *Revue Générale des Chemins de Fer* has now gone the length of saying that in Germany the present general return to compound expansion is attributable to the desire of saving the steam which ordinarily would pass through the valves to the chimney, thus implying that, as 1500 horse-power is indicated by the second expansion out of a total of 3000, makers of ordinary locomotives are careless about the work put into their valves in thus allowing 1500 indicated horse-power to leak through to the chimney! Such statements may pass muster with amateur readers of locomotive *Tit-Bits*, but it is tiresome to practical men who are at all competent in their business. A couple of indicator cards should suffice to disperse this kind of literary smoke screen, but readers, everywhere, have observed that never before so much as now were journals so shy of allowing the indicator cards to be reproduced, whether relating to uniflow or biflow two-stage expansions, for, actually, the average indicator card reveals the following:—

At the Most Economical Cut-off, with 180 lb. Boiler Pressure.

	Single-stage.	Two-stage.
Expansion	3-fold	9-fold
M.E.P. per unit of cut-off, lb. per square inch	65	100
Piston loads, per unit of cut-off, tons	10	15 (7.5 T. per piston)
Horse-power	1,000	1,500 I.H.P.
Ton-mileage per equal coal consumption	10,000	15,000
Maximum stress on cranks, when at 180 deg., tons	20	15
Tractive effort variations per revolution, ton	1.35	1
Variations per revolution at draw-bar, ton	1	0.8

Owing to the greater back pressure set up against the live steam piston, the tightness of the piston valve rings and of the piston segments is not required to be so tense, so that the reduced friction results in less wear of parts per mile†—30 per cent. less cost per annum—the partial equalisation of the pressures on both sides of the piston reducing the extreme variations per stroke between the maximum and mean effective pressures, and so, as shown by any polar diagram from the indicator cards, producing a more regular crank torque, which is transmitted through the heavy tender up to the train head with a reduction of the sharp sagging movements as usually recorded by the dynamometer style. The system is therefore especially suitable for roads with light permanent way or in poor condition, as of Russia and East Central Europe, where, as a matter of fact, it was introduced more as a necessity for the roads than for the 50 per cent. increased power or 33 per cent. reduced coal consumption; and for this same mechanical principle it was finally introduced, against a fierce and singularly bitter opposition, in the marine of nearly all countries, not for the 33 per cent. coal economy which immediately resulted, but for its well-proved efficacy in reducing the number of broken propeller shafts. On British railways, with their superabundance of very cheap coal, of cheap labour, of extra heavy rails and very heavy locomotives, with up to 20 tons per axle, and their small requirements for high speeds to compete with aeroplane and electric services, the need of improved railway locomotives differing in principle from those of the early Victorian period is not so urgent as on the Continent. Tradition and sentiment bind us still to the old George Stephenson engine, always very much as it was in his early patent for the three-cylinder type, and fitted with a slight modification of the Richard Trevithick 1832 locomotive superheater.

Wealth, ease and a magnificent superiority to the penury which compels the Continent to such means—as employed for practically all reciprocating engines in every country, stationary, marine, agricultural, road engines, rollers and motor cars—for extracting the maximum power out of every ton of metal used for locomotives, built at the lowest first cost per horse-power and maintained at lowest labour costs for operation and upkeep, enable us to smile complacently at the envious remarks about "the old Rip van Winkle of steam locomotive engineering" who has thus comfortably remained "Early Victorian" right up to the last days of the steam locomotive.

In view, however, of the desirability of keeping better pace with the aeroplanes used in connection with certain railways, some of the less-sentimental of our companies might find a real utility, and disregarding attendant economies, in the application of that quality shown in the indicator cards of those locomotives utilising their exhaust steam whereby the double expansion autographically indicates precisely the same tractive effort at 260 revolutions per minute as does the single expansion at only 130 revolutions per minute, when the initial steam pressures and the cut-offs are the same in both methods of working. An equal tractive effort maintained up to double the rate of train speed obviously means potentiality for much higher speeds because the speed alone wipes out tractive efforts 100 per cent. earlier in our present engines which expend one-third of their available steam power in the chimney. Of all this there is, of course, now no question. The vital question is of what avail is 50 per cent. increased locomotive power, or 33 per cent. coal economy, if it brings profit to no private individual, since it is not capable of protection or monopoly? The answer is that if our locomotive firms would guarantee to some country now painfully short of locomotives, between 50 and 55 per cent. increased power per ton of the fuel now consumed—peat, wood, coal or oil—and at a first cost for new locomotives of 25 per cent. per horse-power less than in the very best superheated steam locomotives now exhausting steam direct to the air, there would be an excellent chance of securing at least some of the orders which the Russian Transport Commission in Berlin will almost certainly otherwise place with German firms, in Germany and in Russia, on the written guarantee of those results to be automatically recorded and proved by the steam-pressure indicator.

For the sake of trade, we might for a while afford to allow our inviolable attachment to Early Victorian "efficiency" to stand by; above all, as the results will not affront anyone in this country, since the engines—converted from Russia's present single-expansion stock or sometimes entirely new—would not operate their offensive 50 per cent. increased power or 33 per cent. economy in this great country of wealth and abundance. Has any British locomotive firm the enterprise for this, or will the Germans be allowed to sweep in the whole of the orders? Quick action seizes escaping opportunities. It does not suffice to say, "We make any locomotives; people who will can ask for them." Makers, like Maffei, have to create a world reputation for producing engines of the highest efficiency of their own design. Trade then flows from everywhere.

May 24th. C. R. K.

Modern Maximum Efficiency American Locomotives, relatively to European Locomotives of Thirty Years Ago.

Dates	1891	1904	1921	1915
Railways	Russian S.W.R.	Hannover	Penn. R.R.	Erie
Denom.	No. 101	Series S	Class I i s (limited cut-off) goods	No. 50,000 "Pacific" special
System	Woolf compound four-coupled	V-Borries comp. "Atlantic"	Schmidt single expansion	Schmidt single expansion
Condition of tests	In winter, Kiev-Kazatine Two trips, 3½ h. each, four stops each Air brakes. Heating Grades 1: 125	In laboratory Penn. R.R. roller plant St. Louis Exhibition Test No. 709	In laboratory Penn. R.R. roller plant Altoona	Record test —
Cut-offs	Very variable, av. 0.415	0.30	0.40	0.32 (?)
Expansions	8-fold	11.6-fold	2.5-fold	3.1-fold
Boiler pressures	127 lb.–161 lb.	204 lb.	250 lb.	—
General average	140 lb.	—	—	—
Running speeds	Gen. av., 41 m.p.h. Usual service variations	240 r.p.m. continuous	170 r.p.m. continuous	(Presumably 180 r.p.m.)
Steam	Saturated	Dry saturated	Highly superheated	Highly superheated
Quality	Wet	At cut-off, 0.888	About 1.220	About 1.220
Per I.H.P.-hour	18.7 .. 19.1	16.67 (minimum)	15.4 (extreme minimum realisable)	16.85 lb.
Coal, per I.H.P.-hour	2.3 .. 2.1*	[(?) Inquire P.R.R.]	2.9	2.21 lb.
I.H.P.-hours per ton of coal	97 .. 107	—	77	101 H.P.-hours
Engine weights, loaded	43 tons	59 tons	164 tons	120 tons

* Using superheated steam, with the usual test-trip economy of about 20 per cent., this coal rate would be reduced to 1.7 lb. per I.H.P.-hour, or 131 I.H.P.-hours per ton of coal (Russian service in winter).

NOTE.—Steam consumptions per I.H.P.-hour (= coal) reach the minimum, for a given steam density, with the maximum rate of expansion economically practicable in a single cylinder, and according to the tables of mean-pressure constants based on the Mariotte law of expansion, the maximum rate in current practice being about 3.3-fold at a certain moderate speed—say, 180 r.p.m., the consumption increasing to 20 lb. per I.H.P.-hour with increase or reduction of the speed; also if the expansion is increased to 4-fold or more. This result is proved in routine practice, as also by laboratory experiments, using sliding valves, and thirty years' use of trip gear valves in locomotives has only slightly increased the economical expansion rate. Only by consecutive expansions has it been found possible to treble or quadruple current rates without raising the rate per cylinder, the result in actual practice, as also per text-books, being 50 to 60 per cent. augmented power per unit of steam consumed.

of the simple Hornblower-Arthur Woolf (1781–1804) compound system, on the South-Western Railway of Russia, built in France, but it was not claimed for them that their "consumption per 1000 ton-miles was the lowest on record," although this indicated result is, as we see, slightly better than that claimed as the calculated result for the Virginian compounds using superheated steam. And scores of similar instances might be given. With the innumerable little improvements of detail, too technical to recapitulate, introduced in the last thirty years, those Russian engines, with the same saturated steam, and steam pressures, would not to-day exceed 16 lb. feed water per indicated horse-power hour, or 14 lb. with superheated steam. The Vallanoien saturated steam goods compounds of the P.L.M., built at Fives-lez-Lille in 1891, at first averaged during three months 165 lb. of poor coal per 1000 ton-miles, or 20 per cent. less than the non-compounds. Eighteen years later, their average, for August, was only 105 lb., or 40 per cent. lower than when they were first built. The very same engines, with Schmidt superheaters, consumed, throughout the year, more than those without superheaters.

While it is certainly not usual to find a positive annual loss of coal through the use of superheaters, it is none the less quite common to find in inspired articles even such negative results as named above compared with the results given by saturated steam locomotives of thirty years ago, and with the obvious intention of showing how vast have been the economies brought about by the use of superheated steam in that interval. In the German "technicals" we find many examples. The reader is, of course, not supposed to be aware of the important aggregate of very small economies due to the improvement of years in obscure details that are certainly never alluded to in the lengthy descriptions of locomotives given in the engineering Press. In conversation, Mr. Dugald Drummond was wont to show his list of aggregated small economies, totalling up to 30 per cent.,

* Line 48, col. 2, p. 270, March 21st, 1919.

† Line 10, par. 3, col. 3, p. 270, March 21st, 1919.

LAUNCHES AND TRIAL TRIPS.

GLENDEE, twin-screw motor vessel; built by Harland and Wolff, Limited, Govan; to the order of the Glen Line; dimensions, 502ft., 62ft., 38ft. 6in.; gross 9500. Engines, two eight-cylinder four-cycle Diesel, Burmeister and Wain type, 6000 indicated horse-power; constructed by the builders; handed to owners, April 20th.

FU KWANG, triple-screw motor vessel; built by the Rotterdamsche Droogdok Maatchappij (the Rotterdam Dry Dock Company); to the order of the Asiatic Petroleum Company, Limited, of London; dimensions, 257ft. 6in., 37ft., 10ft.; to carry petroleum. Engines, three sets, hot bulb, 420 mm. by 480 mm.; constructed by Ruston and Hornsby, Limited, Lincoln; trial trip, April 21st.

BENGORE HEAD, steel screw steamship; built by Irvine's Shipbuilding and Dry Docks Company, Limited, of West Hartlepool; to the order of the Ulster Steamship Company, Limited; dimensions, 321ft. 3in., 45ft., 23ft.; to carry 4000 tons deadweight. Engines, triple-expansion, 24in., 39in. and 66in. by 45in. stroke, pressure 180 lb.; constructed by Richardsons, Westgarth and Co., Limited, of Hartlepool; trial trip, April 28th.

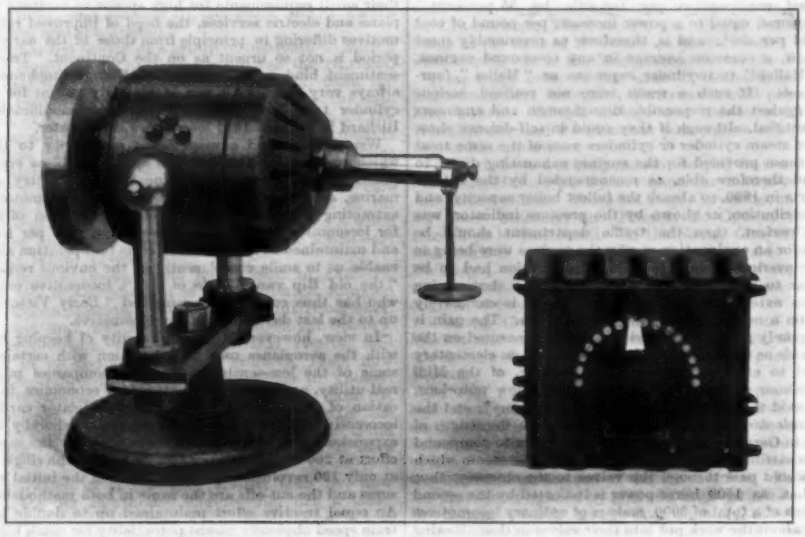
MEROPE; built by Société Provençale de Construction Navales, of La Ciotat; to the order of the Compagnie Auxiliare de Navigation, of Paris; dimensions, 425ft., 57ft., 33ft.; to carry petroleum in bulk. Engines, 28in., 46in., and 76in. by 52in. stroke, pressure 180 lb.; constructed by the builders; launch, May 7th.

ADDA, twin-screw motor ship; built by Harland and Wolff, Limited, Greenock; to the order of Elder Dempster and Co., Limited; dimensions, 450ft., 57ft., 34ft. 6in.; gross tonnage 7800. Engines, two eight-cylinder four-cycle Diesel, Burmeister and Wain type, 6000 indicated horse-power; constructed by the builders; launch, May 25th.

JOHN W. MACKAY, telegraph cable steamer; built by Swan, Hunter and Wigham Richardson, Limited; to the order of Commercial Cable Company, New York; dimensions, 360ft., 48ft., 35ft.; to carry cable. Engines, twin-screw, triple-expansion, pressure 190 lb.; constructed by the builders; trial trip, May 25th.

Motor Gyroscope for Instructional Demonstration.

THE motor-driven gyroscope illustrated herewith has been supplied to the Hong Kong University by Salterns, Limited, of Parkstone, Dorset. The electric motor drives a heavy fly-wheel 7in. diameter, accurately ground and balanced. The apparatus is furnished with a double-pole switch and a shunt resistance giving a very wide range of speed up to and including 1600 revolutions per minute. By adjusting the knurled screw at the end of the load pillar, the gyroscope can be put in proper balance. Weights may then be added to the load pillar, the speed of revolution noted, and the rate of precession observed. The apparatus is mainly intended for experiments in an approximately horizontal plane. The three terminals on the electric motor comprise two for the armature and one for the field circuit. The rheostat is for the field regulation, and is fitted in the field circuit. The spindle of the armature revolves on ball bearings. The trunnions are also fitted with ball bearings, and there is a steel ball on which the whole apparatus turns when precessing. Holes are provided in the base by which the apparatus may be bolted to a firm table. The electrical connections are made by means of flexible cable. On the cross arm, supporting the motor, &c., there is a turned groove for the attachment of a string and spring balance. The total weight of the whole apparatus is approximately 70 lb. As it is almost entirely frictionless, it could, it is claimed, be used for the demonstration of the earth's rotation.



INSTRUCTIONAL MOTOR GYROSCOPE FOR HONG KONG UNIVERSITY

Petroleum Fuel Oils for Diesel Engines.

A PAPER on "Some Characteristics of Petroleum Oils Used in Diesel Engines" was recently read before the Diesel Engine Users' Association by Mr. Harold Moore. The author's work on oil fuels and their use in both internal combustion engines and on furnace firing installations is well known, and in this paper he describes the most important tests which should be made and comments on the bearing of those tests on the behaviour of oils in the engines. Mr. Moore states that we must recognise that our scientific knowledge is insufficient to allow us, without reference to past experience, to predict the behaviour of an oil in an engine as an exact function of its analysis. It is therefore extremely valuable to possess a number of analyses and to have attached to them a brief report on the running of engines on each particular oil. The value of the paper is enhanced by the large number of analyses and tests of representative classes of fuel oil which is given, and it was suggested that members of the Association having oils analysed might write a brief account of their running experience with the oil and transmit the analysis and the report to the Secretary with a view to later publication. Such analyses accompanied by authentic engine reports would be of great value.

An important part of the paper deals with the estimation of the coke, soft asphaltum and hard asphaltum contents of an oil. The coke value is obtained by distilling down a measured quantity of the oil and, after heating until carbonised, the residue of coke remaining in the crucible is weighed. The best method of obtaining this value is that of Conradson, used in the United States. The soft asphaltum is that portion of the oil which is insoluble in a mixture of alcohol and ether, and details of this test are given in Holdes' book on mineral oils. The hard asphaltum is the portion of the oil which is insoluble in light petroleum spirit. These three tests are to some degree a measure of the liability of the oil to carbonise or form coke deposits in the engines, and are a measure of what is the most serious difficulty encountered in heavy oil engine fuels. Probably the most important factor is the hard asphaltum content, as the tests and running results both show that it is really that substance which causes the trouble in internal combustion engines. The results of tests made on four typical asphaltic oils are shown in the following table.

Type of oil.	Specific gravity.	Conradson's coke test.	Total asphaltum.	Hard asphaltum.	Soft asphaltum.
		Per cent.	Per cent.	Per cent.	Per cent.
Heavy Mexican oil	0.966	12.37	20.58	16.43	4.15
Egyptian oil	0.959	10.48	19.55	13.05	6.50
Fuel oil ex Barbados	0.970	6.22	5.80	1.02	4.78
Comodoro Rivadavia	0.942	7.38	23.90	5.86	18.04

For the commercial testing of fuel oils intended for use in heavy oil engines the author suggests that the following series of tests should be generally employed :—

(1) Specific gravity.
(2) Closed flash point.
(3) Cold test.
(4) Heat value.
(5) Ash content, with comment on nature of ash.
(6) Water content.
(7) Coke value.
(8) Hard asphaltum.

The heat value should be omitted when previous analyses of oil from the same source, including heat value determinations, are available. Viscosity tests are omitted as it is possible to estimate the viscosity with sufficient accuracy for fuel purposes by the appearance of the liquid. The subsequent behaviour of the oil in the engine is largely dependent upon the engine conditions, of which the following are the most important :—(1) The speed of the engine, (2) the compressive pressure, (3) the maximum mean effective pressure at which the engine will run, (4) the type of injection, whether with compressed air or mechanical.

During the discussion of the paper it was mentioned that practically the whole of the water and ash content of Comodoro Rivadavia oil might be removed by preheating to 120 deg. Fah. and treating the oil in a centrifugal machine. The same process has also been successfully used for cleaning dirty paraffin oil and separating the water from lubricating oil and water emulsion.

DEFINITION OF COMMERCIAL TERMS.

IN view of the inconvenience experienced as the result of the very different interpretation given in different countries to current commercial expressions, such as f.o.b., c.i.f., &c., the French National Committee of the International Chamber of Commerce, through a special commission presided by M. Hubert Giraud, has, with the assistance of manufacturers, agents, brokers, &c., of Paris, Rouen, Le Havre, Lyons, and Bordeaux, drawn up an international code of the principal terms in use in business and commercial circles.

The definition of f.o.b. is as follows :—"F.o.b. signifies that in the sale to which the term is applied, the transfer of the ownership and of the attendant risks takes place as soon as the vendor has delivered the goods on board the ship chosen by the purchaser, and as soon as the goods have been taken in charge by the ship, all costs of handling before departure, including lading charges and stowage, even when these are incorporated in the freight charges, being payable by the vendor and included in his selling price. When relations with countries other than the United States of America are concerned, the expression f.o.b. alone is sufficient, and it is better not to add the word 'vessel'; on the contrary, in relations with the United States the addition of the word 'vessel' is indispensable."

For c.i.f.—or c.a.f., to use the French translation—the definition of cost, insurance and freight is given, and the definition proceeds : "The transfer of the ownership and the attendant risks takes place as soon as the goods have been taken over by the maritime transporter, but the freight and insurance charges are included in the selling price. Nevertheless, although he arranges for the freight and insurance and takes the freight and insurance charges upon himself in virtue of a contractual obligation, proceeding from the conditions of the sale, the vendor, who, in this, acts only as the agent of the purchaser, incurs no responsibility as far as transport risks are concerned, except in the case of a personal error being attributed to him."

"F.a.s. (free alongside) signifies that, in the sale to which the term is applied, the transfer of the ownership and the attendant risks takes places as soon as the vendor has delivered the goods alongside the vessel chosen by the purchaser, and as soon as the goods have been taken in charge by the ship, the costs of handling anterior to the placing beneath the tackle being alone chargeable to the vendor."

It is hoped that these definitions of the chief current commercial terms will facilitate negotiations between France and countries abroad.

QUEENSLAND'S MINERAL OUTPUT.

THE Queensland Under-Secretary for Mines states that the value of last year's mineral output was £1,456,346, a decrease, when compared with that of the preceding year, of £2,005,539. The principal, if not the sole, cause of the largely reduced production was, he said, the unfavourable position of the world's metal markets. The year 1921 opened with copper—in recent years Queensland's chief mineral product—worth only about £74 a ton in London, a figure below the local cost of winning it. By the end of the year the figure was down £65. None of the copper-producing companies in the Cloncurry district resumed operations after closing at the usual Christmas vacation in 1920, and these remained idle throughout the following year.

Mount Morgan, which in previous years contributed nearly 30 per cent. of the State's mineral yield, closed at Easter, and thereafter added nothing to the year's output. Many other more or less important mining enterprises that could not profitably continue, also ceased operations. Gold mining in Queensland received benefit to the amount of £111,578 out of the total of £840,182 distributed in Australia by the Gold Producers' Association, and this gave considerable relief to gold mining centres of the State. But with Mount Morgan out of commission for nine months of the term a largely reduced output of gold for the year was inevitable. Coal mining, although adversely affected by the depression existing in mining as well as in other industries, with consequent lessened railway traffic, held its own fairly well, and gave a yield not far short of that of 1920.

The value of last year's gold yield in Queensland was £171,504, a decrease of £317,958 compared with 1920. The value of the tin won during 1921 was £98,471. The total quantity of coal raised in Queensland last year was 954,763 tons, valued at £831,483, a decrease compared with 1920 of £10,068 in value. Gems valued at £46,523 were won from the Anakie sapphire field. Little was done in the way of opal mining.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

ALFRED HERBERT, Limited, Coventry, inform us that they have now opened for outside work their gear-cutting department, a description of which appeared in our issue of March 10th last. It will be in charge of Mr. Francis W. Shaw, late works manager of David Brown and Sons (Huddersfield), Limited.

WE are informed that Messrs. Lionel Robinson and Co., of 3, Staple-inn, London, W.C. 1, have been appointed selling agents for the Moler Fireproof Brick and Partition Company, Limited, for the handling of its Moler refractory material which is being put on the market under the trade name of Radmolite.

THE ASSOCIATION OF ENGINEERS-IN-CHARGE.—The twenty-second annual dinner of the Association of Engineers-in-Charge was held at the Holborn Restaurant on Saturday, May 27th, with Captain Riall Sankey in the chair. The attendance of members and visitors was large. The Association was formed to further the interest of engineers in charge of the works at big public institutions and in power-houses. It is usual at its annual dinner to give particular attention to one subject, and on Saturday last the toast of "The Education of Engineers" was entrusted to Dr. Hele-Shaw, with the response by Sir Cyril Kirkpatrick. Dr. Hele-Shaw described the work that had been done by the Institution of Mechanical Engineers by its agreement to supervise examinations held in technical schools all over the country. By raising local examinations to a national level it would in future be possible for anyone who desired to take an examination that would qualify him for entrance to the Institution to sit locally. The next toast was proposed by Sir Alexander Richardson. It was that of "The Association," and the proposer took the opportunity to urge all engineers-in-charge to be ceaseless in their endeavours to educate those under them in elementary economic laws. The President responded. "Our Guests and Friends" was then given by Mr. Alexander Richie and acknowledged by Brigadier-General Magnus Mowat and by Mr. George Mill McKay, Sheriff of London. The health of "The President" was proposed by Mr. W. McLaren, chairman of the Association. An excellent musical programme added to the enjoyment of a pleasant evening.

BRASS CASTING RESEARCH.—We are informed by the British Non-ferrous Metals Research Association, 71, Temple-row, Birmingham, that it has carried out an extensive research on the influence of gases on high-grade brass. A further investigation is now being started by the Association at the Research Department, Woolwich, in which the support of the Engineering Co-ordinating Board of the Department of Scientific and Industrial Research has been secured. The prime object of the present work is to study the conditions necessary for securing both surface and internal soundness of strip brass ingots such as are required for cold-rolled sheet metal. Dr. Harold Moore, and Mr. B. Genders will have charge of the research, which will be conducted partly in the works of members of the Association and partly in the Woolwich laboratories.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

The Manufactured Iron Trade.

MIDLAND makers of manufactured iron report very little modification of the conditions recently prevailing. The iron foundries show few signs of life. Some firms are more fortunate than others, but at best it is not much more than just carrying on. Some little time back there were signs of a slight awakening, but the engineering trouble was sufficient to swamp the improvement, and while things are so unsettled there will be little chance of any improvement. Though prices are weak, they are not quotably lower. There is only a slow demand for marked bars at £13 10s. Unmarked bars are this week quoted at about £11. One North Staffordshire house sticks to the £11 15s. quotation. The recent informal negotiations with the object of some levelling up in the prices of finished iron have ended in failure. Good merchant iron continues to be sold at £10 15s., while anything like an attractive order would bring lower quotations. Nut and bolt bars are still quoted £10 2s. 6d. delivered Darlaston, but rather than lose business, mills are said to have accepted less money in individual cases. Staffordshire and Lancashire bar mills are competing strenuously for the nut and bolt manufacturers' orders. Freights from Lancashire for this class of material have been reduced from about 19s. to 17s., and makers would, of course, like to set this against the loss entailed by the present selling prices, but it is very likely the scramble for the business will force them to hand it on to the consumer. The nut and bolt trade continues to show improvement, necessitating the use of larger quantities of bars, and the position as far as this department of the market is concerned is considered to be quite hopeful. As local material can be bought favourably, Staffordshire bars are generally preferred to Belgian for bolt and nut making. Belgian bar iron is offered at £9, delivered in the Black Country. This is more than £1 below the home price, yet British rollers protest that they are losing money when they sell at the rate now prevailing. Some of them have reached this position, that they quote as near cost of production as possible and refuse to budge. They say they have wooed the market, but their overtures have received no encouragement, and they will waste no more money in the endeavour to redress the adverse balance by striving after a larger turnover which does not materialise. Owing, however, to the exceptional market conditions which now prevail, Belgian mills are not getting any business worth having. Consumers of bar iron want to buy in small quantities according to the necessities of the moment. If they trade with Belgium they will get a lower price, but they will have to buy in advance of their requirements and in larger quantities than the precarious state of their own order books warrants. At a time when the buyer hardly knows what the next day may bring forth the import business with its limitations and its risks is ruled out. The galvanised sheet trade is fairly active, both on home and export account. About £16 to £16 5s. for export is the market level. Iron strip can be bought on rather more favourable terms, and £11 5s. is now a good price.

The Pig Iron Situation.

The limited production of pig iron is still enough to go round, and there is no encouragement to South Staffordshire smelters to re-light their idle furnaces on the basis of existing costs and selling prices. The recent trifling concessions in rail charges scarcely affect the situation. Stocks of pig iron in consumers' hands are small, but they show no inclination to buy for more than immediate needs. Midland smelters are experiencing more difficulty in disposing of their output, and furnaces are finding it necessary to place iron into stock, despite the fact that there are now only ten out of fifty-eight blast-furnaces in active operation in Staffordshire, Shropshire, Worcestershire, and Warwickshire. Only one additional furnace has been re-lighted in South Staffordshire this year, while two North Staffordshire furnaces have recently gone out of commission. So far as the home market is concerned, smelters are receiving little encouragement. The indications that the struggle in the engineering industry is drawing to a close have given no impetus to buying. Foundries and forges are carrying on, if they are working at all, with the smallest margins of stock, and no possibility of shortage makes any impression on the market stagnation. Apparently the engineering firms have decided to postpone purchases of material until the strike is actually settled. In these circumstances the export orders which are reaching smelters are doubly welcome. Some Midland furnaces appear to be finding better outlets abroad than at home just now. Many Northamptonshire firms are striving very hard for this business, and are sending supplies to the Lincolnshire ports for shipment. Foundries at home that were supplying engineers' castings are getting fewer orders as contracts which were in hand at the beginning of the lock-out are completed, and this fact reacts on the market. Increasing numbers of engineers in this district are returning to work as the result of negotiations with their employers, but while large centres like Coventry, Barrow, and Glasgow have their engineering establishments shut down, any substantial improvement in demand for raw material is considered impossible. Manufacturers, nevertheless, are quite decided that progressive improvement in business only requires pacific conditions to manifest itself much more decidedly. The early arrival of summer heat has interfered with production in some branches, but the present small requirements of customers are so easily met that the disorganisation is immaterial.

Steel Competition.

Orders for steel are reduced to the lowest proportions. There are reports of undercutting, but a stage has been reached in which the principal makers are indifferent to this sort of competition, their view being that the rates laid down by the associated makers cannot be safely lowered, and that the only policy is to hold on till the stagnation is over. Steel bars are now freely offered at £9 5s. For the most highly esteemed makes not less than £9 10s. is required. After maintaining prices of semi-finished steel for some weeks past at £7 15s., the Welsh steel mills are now accepting £7 10s. to meet the competition from the North of England, which, as I pointed out last week, has lately been a good deal in evidence. Buyers stipulate for immediate delivery of the very small quantities they order. Where purchases run to 250 or 500-ton lots in normal conditions, they are now confined to 25-ton lots. The majority of the orders are so small that producers do not care greatly whether they secure them or not, for they involve repeated readjustments of plant. Manufacturers of finished material state that the reduction in railway rates is too small to give inland producers any better share in the export trade. On the other hand, relatively cheap freights are increasing the danger of a recrudescence of continental competition in the British market, while they give the foreigner a big pull in neutral markets abroad. Belgian firms have sent into this district fresh quotations for finished material, most of which are well below those emanating from home steel works. Joists, for example, are offered delivered in Birmingham at £8 14s. 6d., against the home price of £10 10s., and angles at £9 6s. as compared with £10. There is also some cutting of billet prices at £7 7s. 6d. delivered.

Improved Edge Tool Trade.

For a few weeks past now the edge tool industry of the Black Country has been showing signs of improvement, and orders have been coming along more regularly. A decidedly more hopeful tone now generally exists, and makers are looking for better times. The huge stocks of goods which the Government had to dispose of at the end of the war are still being liquidated by the contractors who obtained them, and thus normal orders are affected. Nevertheless, the home trade has improved, and there are signs of improvement in the demand from abroad. South American trade is a little better, and there is a movement in the East, while colonial buying is on the increase. Prices are unchanged, and they are not likely to change failing an appreciable drop in the cost of raw material or fuel, which does not seem likely at the moment.

The Foundry Industry.

The importance of the Foundry Trades Exhibition, to be held this month, to Birmingham may be gauged from the fact that the Midlands is undoubtedly the largest centre of the foundry industry in the country. It is not only the centre of the malleable iron trade—there being 134 malleable foundries in the district out of a total of 178, and nearly all the non-ferrous foundries are also in the area—but out of a total number of 2796 grey iron foundries in the whole country no less than 988 are in the Midlands, of which Birmingham is the natural industrial and distributing centre.

Nuneaton Pit Closed.

Stanley Brothers' Nuneaton colliery has ceased operations. "Stanley's" is one of the biggest pits in Warwickshire, and at one time employed about 1300 workers. For some time difficulty has been experienced in running the pit on a profitable basis. Negotiations between the management and the Miners' Association officials have taken place from time to time, and, as already recorded in these columns, several new arrangements have been tried, but all without success. A few months ago the directors found it necessary to close one part of the pit. Fresh efforts have since been made to make the undertaking pay, but at a meeting of the directors last week it was decided to close the pit down permanently.

Serious Situation at Cannock Chase.

There has been a serious development in regard to the Cannock Chase coal industry. Following upon the announcement last week-end that, owing to the prevalent trade depression, there would be a "general" stoppage at all the pits during Whit week, a request has been received by the Cannock Chase Miners' Association from the West Cannock Colliery Company that the miners in its employ—about 3000 in number—should agree to a reduction of wages equal to over 40 per cent. on the standard wage at present prevailing under the ascertainment of the Midland Wages Board. The company made it clear that the financial position justified the request, and that the future working of the pits under its control depended upon the attitude of the men towards the proposal. This fact notwithstanding, there is emphatic hostility to the suggestion, and a resolution rejecting the request has been unanimously carried at a mass meeting of the miners. Consequently, at the time of writing most of the collieries in the Cannock Chase district are idle.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

Iron and Steel.

THE general condition of the markets has not changed to any serious extent this week, and buying is, if anything, rather slacker than it was, because it is realised that nothing can be done now until the Whitsuntide holidays are over. That period is, for Manchester and district, a much more serious break in business than it is in London, and even in ordinary times business is slack in the week before and the week after. It seems to be generally assumed that the labour troubles will all be over by the second week in June, and if we then have a clear six months' work before us something may be done to rehabilitate the markets and get some restoration of confidence. One has some hesitation in estimating the damage already done to the trade of the district by the stoppage, for nearly three months, of industry in the engineering works, but it is probably much greater than many people think. There seems to be an idea prevalent that these stoppages can take place, and then, after they are over, business will be taken up just as though nothing had happened. Of course, there may be a sharp spurt in demand which will give the appearance of prosperity, but it will be a deceitful appearance.

Copper, &c.

The market for copper has shown considerable strength lately, and fortunately for copper producers this market is not absolutely dependent upon the British engineering trade. There is a growing feeling that the lowest prices for standard and refined copper have now been passed, and this seems to have induced some speculative business, although yet not to any very great extent. The total rise in copper since the lowest point in April has been nearly £5 per ton, and that this has come about gradually is an indication of improvement. There is the increased production of the next three months to be met, and people are not yet very sure that consumption will increase proportionately, so that the prices may be maintained. The danger is that producers will try to make the market move too fast for safety; for if by reason of this there should come another set-back, the growth of confidence would be checked for a considerable time. Consumers of copper seem to be more inclined to buy for stock than they were, and if this inclination increases it will make a very considerable difference, because then the burden of holding the total stock of copper will be more evenly distributed. The actual consumption of copper in this country is, of course, small, and cannot increase greatly until all the engineering works are busy again; but it seems to be better in America. The proper co-ordination of the prices for refined copper and manufactured metal is still being waited for, and perhaps may be helped on if later there should be more work for the metal manufacturers. Both in the iron trade and the metal trade it is disastrous to have such a great disproportion between the capacity of the works and the appetites of the consumers. Lead remains a very strong market for near delivery, the scarcity of prompt being particularly noticeable in London; but the "backwardation" for forward delivery is increasing, and this is not a favourable sign for the future. Stocks are, however, very strongly controlled, and one cannot guess when the collapse is likely to come. Spelter has been moderately firm, and there is an upward tendency. The Continent does not offer much, but the British production is growing slowly. Galvanisers have been buying more of late, but the brass trade remains a very poor consumer.

Pig Iron.

The market in Manchester for pig iron is now very quiet, and the influence of the coming holiday is felt earlier than usual. It is fairly clear that people are only too glad of the holiday time to get rid for a few days of the perplexities of business. The tendency to buy foundry iron in anticipation of a possible scarcity and rise in price on the return of the engineers to work seems to have subsided. Very few people are buying iron this week, but the nominal price is maintained at 92s. 6d. per ton delivered in Manchester for Midland No. 3. As your readers will probably know, there has been a slight concession in the railway rates on pig iron, but this does not make much difference on the short-distance rates. The rate from Derbyshire furnaces is still about 8s. 9d. per ton, as against the pre-war rates ranging from 4s. 9d. to 5s. 3d. The concession on the rates from Scotland is more important, but the effect of this on the Manchester prices is counteracted by the advance in the furnace prices for Scotch iron. The Scottish ironmasters have been getting more export business, and as their prices are low compared with Cleveland this seems to be natural enough. In spite, therefore, of a reduction in the rate, Scotch iron in Manchester is rather dearer than it was before.

Finished Material.

The market for manufactured iron and steel is in a very poor condition at present. There are fewer buyers about than before, but this is mainly the effect of the coming holiday. Consumers seem to have no apprehension of a rise in these prices when engineering work is resumed, and are not likely to buy much material for other than prompt delivery. The nominal official prices are unchanged, and no alteration seems to be expected at present. It would, of course, be impossible to stimulate buying now by concessions in the prices.

Scrap.

There is less than ever being done in the scrap market this week. Foundries have not begun to buy, and there is no reason why they should, because there is plenty of foundry scrap about, and dealers are anxious for orders. The nominal prices for cast scrap range from 80s. to 90s. per ton according to quality. Wrought scrap is at 60s. per ton, but there seems to be a little better feeling in steel scrap, which has, of course, been unduly depressed here for a long time.

The Thirlmere Aqueduct.

At a meeting of the Manchester Waterworks Committee held a few days ago it was reported that the work of laying the new 54in. main between the city and Thirlmere had been begun at Oxenholme, Caton, and Grimsarge, and that a beginning would be made at Deepdale immediately. It is expected that the work will be completed in 1926. The completion of this line will add 15,000,000 gallons daily to the Manchester supply and exhaust the capacity of Thirlmere.

South-East Lancashire Electricity Scheme.

A conference will be held in Manchester on June 20th, when the next step will be taken in the scheme to co-ordinate the electricity supply in South-East Lancashire. It will be recalled that the Electricity Commissioners held an inquiry in January last, when representatives of the bodies interested in the proposal gave evidence, the great majority favouring the proposal. The Commissioners have approved the scheme, and they will be present at the conference next month when the various public authorities and others will consider the drafting of the Bill to be presented to Parliament.

Agecroft Electricity Generating Station.

The proposal of the Salford Electricity Committee for the erection of an electricity generating station at Agecroft was finally approved at a special meeting of the Salford Council last week. The recommendation of the Committee that application should be made for sanction to the borrowing, under the provisions of the Electricity (Supply) Acts, of the sum of £709,287 to cover the cost of erection, was adopted. In replying to criticism of the scheme, Councillor Billington, the chairman of the Electricity Committee, said that all the objections that had been raised had received their careful consideration. They had been satisfactorily assured by the responsible Government authorities that the principle of deferred payments, whether of interest or sinking fund charges, was bad finance. While it was true that the Committee sought the power to suspend the repayment of the borrowed money while the expenditure out of that money remained unremunerative, it would not use that power unless it was necessary. They were convinced, however, that the sinking fund charges could be met out of their surplus funds, and that the whole scheme could be financed without burdening the rates. The object of the Committee was not to make a profit but to provide a service which would benefit the consumers.

Cost of Barton Power Station.

Speaking at a meeting of the Rotary Club in Manchester last week, Mr. S. L. Pearce, chief engineer and manager of the Electricity Department of the Manchester Corporation, said that the capital outlay on the Barton power station had been very heavy, totalling about 3½ million pounds sterling—on the station about £2,400,000, on the transmission lines £650,000, and on distributing stations about £230,000 to £240,000. Roughly speaking, the cost of every kilowatt installed at Barton, as compared with what the cost would have been in 1915 and 1916, was about 2½ times as large. The effect of the high capital outlay could be minimised to a great extent. The station had been designed to reduce to the lowest possible basis the coal bill and labour charges and to ensure a high degree of reliability. The plant must be run for the maximum number of hours possible. It must become what the Americans called a "base load" station. There was no reason why 60 per cent., and possibly more, should not be attained. At Stuart-street it was about 40 per cent. At Barton, as compared with Stuart-street, the coal consumption would be reduced by at least 30 per cent.

BARROW-IN-FURNESS, Thursday.

Pig Iron.

But for the continental trade in the hematite pig iron industry there would not be a great amount of business being done. The steel departments in the district are not very fully employed, and this fact is attributed to some extent to the prolonged engineering lock-out. These departments take a fair amount of iron, and therefore it is possible, if the consumption falls away, more will have to go into stock or there may have to be some damping down. There is plenty of hope for the future as soon as labour and the employers come to terms. The iron trade would soon improve then.

Iron Ore.

The iron ore trade, as far as local mines are concerned, is confined practically to the district, and there is not a great amount of business being done at the moment. It will not be until the iron trade gets re-started that the mines will become active again. Some are fairly well employed, while others, including the most important, are closed. Spanish ore is being imported in limited quantities.

Steel.

The steel trade is not very brisk or promising, and the labour lock-outs are affecting it. Some of the works have orders on hand, but in no case, except, perhaps, the hoop mills, are any long runs anticipated. There is not a great amount of orders in the market. There may be a better chance if the Admiralty decides immediately to place orders for two battleships, as there is some talk of its doing at present. The result of the deputation to London has brought the state of trade in Barrow and similar towns prominently before the Government, and two officials are coming to Barrow to confirm the reports. Barrow is hoping to get some work from the Admiralty as a result.

SHEFFIELD.

(From our own Correspondent.)

Universal Holiday.

DISAPPOINTMENT has succeeded the more hopeful outlook of a week ago when it was felt there was a prospect of a settlement of the engineering dispute. In that expectation an increasing number of men had presented themselves at the various works each day, and for a time it looked as if there would be a gradual drifting back until the situation settled itself in this way. That anticipation has not, however, been realised, and now that the jobs in hand which could be completed without any considerable engineering assistance have been dealt with there is an increasing difficulty in finding work for those men who are not directly affected by the dispute. The result is that more firms than ever before in the history of the dispute have been compelled to close down, or are on the point of doing so. Advantage is being taken of the fine spell of weather to take holidays, and the east end of the city is now practically deserted and many of the huge works silent.

Lucky Exceptions.

At the same time there are a few fortunate exceptions to this sorry spectacle. One of the sections in which there is still a moderate amount of business being done is in the manufacture of cold-rolled strip, which seems to be in considerable request, largely in connection with motor car construction. The majority of the rolling mills in this branch of the trade are running full time. Arthur Lee and Sons, Limited, for instance, report an increasing demand during the past few weeks, both for cold-rolled strip and wire, and the bulk of their orders is for the home market, a fact which suggests that some branches of British engineering have reached a turning point. There is also a better inquiry for certain kinds of edge and building tools, colliery tools, and mining steel, and in a lesser and diminishing degree for agricultural tools. The season for gardening and farm tools has, in fact, ended far more briskly than it began. The implement trade is, however, very indifferent, and local firms catering for that industry report the poorest season on record. There is, of course, a big market awaiting in Eastern Europe if only means of payment could be arranged. Another department which has apparently come to the end of its spurt is the home demand for hematite pig, Sheffield consumers no longer having any call for it with so few furnaces in operation. Germany is, however, still buying supplies.

A New Electric Furnace.

Considerable interest has been taken in demonstrations during the past week of a British-made electric furnace adapted for the melting of non-ferrous metals. It is a rotating furnace designed and made by T. H. Watson and Co., of Sheffield, for the proprietors of the Greaves-Etchells electric furnace. The furnace is of the independent arc type and of 2-cwt. capacity. It is in the form of a barrel, which is rotated when a bath of metal is formed in order to ensure the complete mixing of the alloy. It is claimed to effect a considerable reduction in cost as compared with present methods.

The Sheffield Electricity Area.

It is announced that the postponed inquiry concerning the electricity supply grouping scheme for this area will shortly be held in Sheffield. The area extends something like forty miles from east to west and twenty miles from north to south, embracing Buxton and Doncaster, Rotherham and Chesterfield. Some of the authorities concerned are not enamoured of the scheme, suspecting Sheffield's embracing designs, but it is expected that it will be approved. If, as is expected, the unification of the electricity undertakings in this great industrial area popularises and cheapens the use of electricity, it will materially assist the smoke abatement movement, which has been making some headway of late. At a conference of Yorkshire authorities held this week at Wakefield it was asserted by one of the experts that a saving of fifty million tons of coal a year could be effected by the general adoption of the modern system of firing. It was, said Mr. Casmey, a question of giving the correct proportion of fire-grate area to outlets at the ends of the flues through which the products of combustion were allowed to escape. Mr. W. Nicholson, the Chief Smoke Inspector of Sheffield, who has also made a lifelong study of the smoke question, said the need for a national propaganda was evidenced by the fact that to-day 95 per cent. of the municipal authorities in this country had never tackled the question in any way. From another standpoint the subject has also been discussed within the last week by Professor J. W. Cobb, of Leeds University, in the course of a series of lectures on "Coal," arranged by the Department of Fuel Technology of Sheffield University. He remarked that the smoke nuisance could be abolished by either carbonisation or gasification, but although the hygienic and æsthetic advantages of a smokeless atmosphere were thereby secured, one could not lose sight of the fact that both thermal and monetary expenditure was incurred in carrying out the processes. Producer gas, because of the way in which it lent itself to the application of the regenerative principle, could be used for obtaining temperatures and carrying out processes which were impossible with raw coal. The open-hearth steel process was quoted as an example. In some other operations, such as the raising of steam, the justification was by no means so easy to make. How far carbonisation or gasification of coal became general was likely to depend more than anything else upon the value of the products as compared with the cost of the original coal plus the cost of the process to which it had been subjected.

New Glassworks.

Members of the Midland Section of the Coke Oven Managers' Association visited the Barnsley works of Messrs. Wood Bros., who have recently put up new premises principally for the purpose of manufacturing laboratory glassware, a section of the industry which in the past was almost entirely in the hands of the Austrians and the Germans. Mr. J. H. Davidson, the chief chemist, was formerly lecturer in glass technology at the University of Sheffield, where, as collaborator with Dr. Turner and Mr. Frank Wood, head of the Barnsley firm, he was largely responsible for the launching of the Society of Glass Technology which was founded for the purpose of stimulating scientific research in the manufacture of glass, and has been remarkably successful.

Colliery Developments.

Further colliery developments are in progress just outside Doncaster, sinking operations having commenced at Armthorpe. The new pit, which will be the nearest to Doncaster and only half a mile from the racecourse, is the property of the Markham Main Company. It is proposed to sink the two shafts simultaneously. Permanent headgear and large concrete outbuildings have been erected and arrangements are being made to deal with any water difficulty that may be encountered by the cementation process. It is hoped to reach coal at a depth of about 600 yards, and the colliery will be one of the largest in the Doncaster coalfield. The lay-out of a small town on model lines has been prepared and already fifty-two houses are occupied. At another suburb of Doncaster —Askern—a miners' welfare scheme includes the purchase of the Askern Hydro, which was formerly a popular resort for visitors to Askern Spa in the days when it was thought the future prosperity of this delightful spot lay in the development of its sulphur waters. Coal has, however, proved to be more profitable.

Items of Interest.

At the recent meeting of the Iron and Steel Institute in London, an important paper by Mr. Fred Clements, of the Park Gate Iron and Steel Company, on "British Siemens Furnace Practice," was discussed at considerable length, but in view of its value it was felt that a special meeting should be called for its further consideration. This meeting has now been arranged for June 13th, at the Mappin Hall of the University of Sheffield. The local steel and engineering industry has lost by death a well-known figure during the past week. Mr. John T. Middleham, secretary and a member of the directorate of Hadfields, Limited, died at Bournemouth. Mansfield is the latest addition to the lengthening list of local authorities which have adopted the bio-aeration system of sewage treatment developed by Mr. R. Howarth, the chemist in charge of the Sheffield works, and described in THE ENGINEER some months ago. Sheffield steel makers have not yet despaired of getting some Admiralty orders. I understand that at a recent interview with Mr. Amery representatives of the principal industrial centres which have been badly hit by the suspension of battleship work, received an assurance that the Government does not propose to abandon the construction of the two new battle-cruisers.

NORTH OF ENGLAND.

(From our own Correspondent.)

The Trade Position.

THE past month has been an extremely disappointing period for the various industries on the North-East Coast. It is probably true to say that at no time in the history of trade has the negotiation of business been more difficult, and the position has been greatly aggravated by the prolongation of the engineers' dispute. Confidence in the outlook has been shattered for the time being, and is not likely to be restored until a settlement of the unfortunate labour trouble is reached. The paralysing effect of the dispute is being increasingly felt in the iron and steel trades. Home business is in a state of almost complete stagnation, and the spurt in foreign trade has exhausted itself. This week two more blast-furnaces have been put out of operation. Both have been producing hematite pig iron, and as two more hematite furnaces were recently put out of action, there are now only twenty-five in operation on the North-East Coast, as compared with twenty-nine a fortnight ago.

Cleveland Iron Trade.

Business on the Cleveland pig iron market has been extremely slow this week. There has been a further curtailment of orders from the home foundries and engineering works, owing to the disturbed industrial situation and the disinclination to trade has been accentuated by the approach of the Whitsuntide holidays. But if the demand for iron be small, production is also limited, so that there has been no very great accumulation of stock, and if, as is now anticipated, the forty-seven unions agree to the new terms of settlement and return to work, it will almost certainly involve the lighting up of more blast-furnaces. A full resumption of work, will not, of course, be possible until the Amalgamated Engineering Union also settles its differences, and that seems likely to be a little longer delayed, but if the forty-seven other unions go back, it will enable the foundries to restart, and thus directly affect the home demand for pig iron. Altogether, despite the present slackness of trade, makers are hopeful of better business after the holidays, and adhere to their recent prices. No. 1 and siliceous iron is 95s., No. 3 G.M.B. 90s., No. 4 foundry 87s. 6d., No. 4 forge 85s., and mottled and white 80s.

Hematite Pig Iron.

The demand for East Coast hematite pig iron has fallen off considerably, and only small parcels are now changing hands. There is, however, no disposition to cut prices below 95s. for mixed numbers and 90s. for No. 1, and, indeed, some of the makers refuse to sell at these figures.

Iron-making Materials.

The imports of foreign ore into the Cleveland district during May have exceeded 200,000 tons for the first time since 1921. But big deliveries do not connote big business. On the contrary, the market is absolutely flat, consumers having bought all they need, except when a cargo is required for mixing. Still, sellers can make no further concessions and refuse to accept less than 27s. per ton for best Rubio ore of 50 per cent. quality, though good Mediterranean ore can be bought at 23s. 6d. per ton c.i.f. Fuel prices are not appreciably lower, but there are no fixed quotations, prices being subject to negotiation. Good Durham furnace coke, however, commands from 27s. 6d. to 28s. per ton delivered at the works.

Manufactured Iron and Steel.

The slump in the manufactured iron and steel trade seems to become more and more pronounced. Very little of the steel plant is now working, and there will probably be a complete week's idleness next week. It is hoped that things will brighten up when the engineers get back, but the present state of the trade is deplorable, and there is keen cutting for foreign orders, although the prices for home trading are maintained.

The Coal Trade.

The Northern coal trade position is not much changed from the condition of the previous week. There is a quiet and restrained feeling abroad, together with some uncertainty respecting future possibilities. As a matter of fact, the collieries are very anxious to secure as far as

possible something like an assured regular working for the next two or three months, at least, in the hope that by the end of the summer the home trades will have so much improved that the demand for the home market will be greatly augmented over the winter months. The inquiries from the usual sources abroad are slow. Very little business is in progress for Italy or any of the usual Mediterranean areas, while from France and Sweden not much is expected for some time to come. The export trade is depending very largely on the German business, which is fortunately keeping fairly heavy, and it is likely to continue for a few more months at least. No great hopes are entertained with regard to American business. There are inquiries in hand, including some for fairly large quantities, but so far nothing much has been booked, and not much is expected, although there should be an influx of business from South America in the event of the American labour troubles proceeding for any length of time. The Northumberland steam coal section is, on the whole, fairly steady for a week or two ahead, but there is by no means much strength or assurance in the forward position, and ideas regarding the forward outlook are extremely variable. Best brands of screened steams are steady, which is also the case for Tyne primes for prompt, but there are factors present which disturb forward prospects. Second steams are barely steady, but smalls are well placed. The Durham market is patchy and extremely erratic. Many producers of best and special classes of gas and bunker coals are free from anxiety over the next week or two, but this is by no means uniformly the case, while for second gas, coking or ordinary bunkers there is only a moderate inquiry, and values are beginning to fluctuate considerably. The coke market is moderately steady.

Oil Bunkering Facilities on the Tees.

The prospect of a gradual and comprehensive conversion of vessels from coal to fuel oil burning, with consequently wider and newer possibilities to ports hitherto not largely concerned with bunkering, has been as much discussed on Teesside as elsewhere. It is a contingency for which the Tees Conservancy Commissioners have paved the way to some appreciable extent, and now arrangements are being made for the supply of fuel oil to ships, both on the northern and southern banks of the river. In connection with their projected deep-water berth, Bolckow, Vaughan and Co., Limited, have recently acquired the large storage tanks in the vicinity of Eston Jetty, previously belonging to the War Department. In addition, Bell Brothers, Limited, are providing oil-bunkering facilities on the north bank of the Tees.

SCOTLAND.

(From our own Correspondent.)

"Hand-to-Mouth" Conditions.

WHILE at times the dulness in the various industries is relieved somewhat by hopes of trade improving conditions generally remain devoid of encouragement. A settlement of the engineers' dispute might mean a substantial increase in business, but even that is problematical. Home prices are now on something approaching a competitive basis, but still further reductions would be necessary in order to give producers an even chance in open competition. At current rates makers report little, if any, profit; in fact, orders are often taken simply to keep works open. At present nothing apart from the smallest possible requirements are being bought, consumers showing a disinclination to take any advantage of the chance of cheap lines. The reductions in railway rates now in force are not calculated to bring down prices. Manufacturers may receive some very slight relief in production costs, but selling prices will not be affected. Hope is entertained of an early settlement of the trade disputes, but the year is too far advanced to leave much hope of any revival in trade before the summer holidays, even should industrial peace be accomplished before then.

Pig Iron Dull.

The pig iron market is very inactive. The production is small, but stocks continue to increase. Local requirements are few and for small quantities, and though export inquiries are fair only a small proportion ends in business. Prices are nominally unchanged, but the tone is weakening. At the weekly meeting of the Glasgow pig iron "ring" there were sellers of No. 3 Scotch warrant iron at 97s. f.a.s. Glasgow, No. 3 Cleveland warrant iron at 93s. f.o.b. Middlesbrough, and mixed numbers East Coast hematite makers' iron at 95s. 6d. f.o.b. Middlesbrough. No business was done.

Steel and Iron.

The present outlook for steelmakers is rather depressing. For some time now foreign competition has slackened off, but the influence of Belgian and French producers is again apparent. Recent foreign quotations for steel bars, billets, &c., point to the necessity for still lower home prices if makers are to retain the business they have managed to regain. The home demand for steel is lessening every week. Home orders are almost dried up and export only occasionally proceeds beyond the inquiry stage. Steel plates and sectional material are doing next to nothing. Black and galvanised sheets have lost their activity. Malleable bar iron is dull in the extreme. Specifications for both iron and rolled steel bars are scarce. Prices for bar iron remain unchanged. Re-rolled steel bars have been usually quoted about £9 10s. per ton both home and export, but this price is likely to be lower soon in view of cheaper billets. The demand for scrap supplies is almost the only bright spot meantime. Continental inquiries are regularly maintained, and now home consumers are beginning to move. Heavy smelting steel scrap is offered at about 57s. 6d. per ton, and fairly good business has been done at that figure.

Ironworkers' Wages.

With the average net selling price of malleable iron during March and April certified at £11 13s. 3.08d. per ton, the wages of the workers are liable to be reduced by 10 per cent. on basis rates.

Coal.

Apart from a better inquiry for washed materials for export the Scotch coal market generally is quiet. The position in Lanarkshire is particularly disappointing, additional collieries in that area having been forced to suspend operations. No change can be looked for until the labour troubles are settled. Fifeshire collieries are not doing too well and only in Stirlingshire and some parts of the Lothians are there signs of activity. Collieries in the latter district have benefited by the recent demand from Hamburg and Rotterdam. All over, however, there is a considerable amount of broken time. There is a great scarcity of outlets for round coal, and consequently washed materials are scarcer and thereby somewhat firmer in price. Home demands are practically at their lowest ebb at this time of the year, and the lack of industrial orders is most severely felt. Prices are most irregular and some cheap lots are available. Consumers, however, are not anticipating requirements even with a price inducement. Aggregate shipments for the week amounted to 273,911 tons, against 290,123 tons in the preceding week, and 347,502 tons in the same week in 1913.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

SINCE writing a week ago a change has come over the steam coal market, and that not to the advantage of the industry. The conditions prevailing are by no means so favourable as was the case a little while ago. Notwithstanding that the collieries have a fair amount of business on their books, they are unable to maintain their prices for the reason that the general inquiry from abroad has been gradually declining for some weeks past, and matters are now coming to a head. The collieries are now really feeling the effects of the dearth of trade. Reference has on several occasions been made to the fact that the demand so far as France and Italy are concerned has been flat, and that it is not much better in the case of Spain and Portugal; but the lack of orders from Italy and France was bound to tell its tale in the long run. These are markets that are of the highest importance to this district. Inquiries from other quarters do not compensate for their dulness, and, unfortunately for the collieries, nothing has come of the reported demand for coals for America and Canada. Undoubtedly prices went forward, but it is pretty evident that the inquiries were speculative rather than definite. However, the position is that business has not matured. A great deal was made of the reported possibilities of large shipments being effected, but as a factor in bringing buyers in other countries on for supplies it has not been a success. The view held very largely by consumers abroad is that prices will fall, and the chances are that they will be right, as South Wales coal prices are high compared with those for North Country coals. South Wales coalowners have this week considered the situation and the steps to be taken to check the fall in prices, and there is to be a special meeting at an early date to see what can be done to stabilise the conditions. It is very difficult to see what they can do more than they did some months ago, when the market was in a very depressed state. It was then arranged that the colliery salesmen should periodically meet together to consult one another regarding prices and as far as possible avoid undercutting. Definitely to fix prices is looked upon as impracticable, and indeed it is to be doubted whether some of the leading undertakings would agree to bind themselves to such an arrangement. They prefer to be free, yet they are ready to do their utmost in a general way to maintain prices.

Dock Charges.

The announcement was made last week that the Great Western Railway had decided to make some concessions in dock charges as from June 1st. Tonnage rates on vessels, excluding dock rent—i.e., dock dues calculated on the ship's net register tonnage—are reduced to 100 per cent. over those in operation on December 31st, 1913. This arrangement does not, however, apply to vessels taking bunkers only, for which the rate will remain at 10d. per net register ton as at present. The charge for shipping and weighing coal at coal hoists will be reduced from 11d. to 10d. Thus, while tonnage dues are reduced to a uniform increase of 100 per cent. over the pre-war rates, the charges for bunkering to foreign ports will remain at 150 per cent. above the pre-war level, and those for tipping and weighing 344 per cent. higher. The General Committee representative of the traders has considered the reductions, and the secretary, Mr. Finlay Gibson, has issued a statement giving the reply of the Committee, which is unanimously of the opinion that the proposals of the Great Western Company are totally inadequate to meet the present serious position both of the coal and shipping trades. The charges at the Bristol Channel ports owned by the Great Western Company will, after allowing for the reductions, still be higher than those in operation at other ports, and traders using them will therefore continue to be handicapped in their competition with other districts. The Committee expresses its regret that it cannot regard the present concessions as being a settlement of the question, and it has asked Mr. Felix Pole to receive a deputation. The Committee is now preparing its case for a further reduction in charges, as it is unanimously of the opinion that further concessions must be made by the Great Western Company if the coal and shipping trades are to be again placed on a proper economic basis, and further, it is essential that the trade of the Bristol Channel ports shall be subject to very much lower charges than those now existing.

Ebbw Vale's Future.

Opening an institute on Saturday last at Trevil, the village of quarrymen on the outskirts of Tredegar, Sir Frederick Mills, the managing director of the Ebbw Vale Company, said that it was quite correct that they had started a new process at the Ebbw Vale works. The process was at least fifty years old, but its application was new to Ebbw Vale. It was a success metallurgically, and no doubt it would be a success commercially when the difficulties had been overcome under the able guidance of their new manager, Mr. Hann. When these difficulties had been surmounted, which would be soon, a new era of prosperity would dawn for Ebbw Vale.

Tin-plate Trade.

A scheme was put forward some time ago with the object of preventing undercutting in prices in the tin-plate trade, &c., the proposal being to regulate production by means of a pooling arrangement. The scheme, however, came to nothing then, but the proposal has been revived, and has been agreed upon between tin-plate makers on a contributory basis. It is expected that the practical operation of the scheme will go a long way towards stabilising the trade and do away with undercutting. It is to come into operation on July 3rd.

Current Business.

The current demand for supplies of coal is very limited, and the market is certainly weaker compared with its condition a week ago. The easing down applies practically to all grades of steam coals, but especially to sized qualities. Many collieries have great difficulty in keeping going, and unless the inquiry revives it is to be feared that the middle of June will see a number of undertakings on short time. It has been definitely decided that there will be no work in the coalfield during Monday, Tuesday and Wednesday of next week, and there will also be no tipping of coal at the docks on Monday and Tuesday. It is possible that the restriction in the output of the collieries next week as a result of the holidays may steady the conditions for a time, but the market requires a good deal of fresh inquiry to put any life into it. Large and small coals are down from 6d. to 1s. per ton as compared with a week ago, while nuts and peas have fallen 2s. 6d. per ton, as the demand is so poor. Anthracite coals for prompt shipment are not so firm, but for forward loading the tone is well maintained, and colliery salesmen are not disposed to make any firm offers for supplies ahead.

Cardiff's Imports.

One of the branch firms of the Imperial Tobacco Company, Limited, has decided to make the port of Cardiff a permanent depôt for the importation of unmanufactured tobacco. It has secured the necessary warehouse accommodation and will make Cardiff one of the distributing centres.

Swansea Metal Exchange.

A fair business is reported to have been done in tin-plates recently, and the tone prevailing is better. The galvanised sheet market is more active.

CATALOGUES.

VACUUM BELTING COMPANY, Indianapolis.—A copy of folder on vacuum genuine hoghide belting.

THE AUTOCRAFT BOARD, 1, Harewood House, Hanover-square, W. 1.—A small tin of paste called "Grip-fix" has been received from this company.

THE STANTON IRONWORKS COMPANY, Limited, near Nottingham.—A copy of the firm's list of cast iron pipes, which are available for immediate delivery.

WELCO PATENTS, 150, Alma-street, Birmingham.—A copy of a folder entitled "Comfort." The Welco electric pedestal fire is illustrated and described and prices are given.

SOCIETE ANONYME ETERNIT PIETRA ARTIFICIALE, Norfolk House, Laurence Pountney-hill, E.C. 4.—A copy of a pamphlet entitled "Italit" corrugated asbestos-cement, sheets and ridges.

TANKS AND DRUMS, Limited, Bowling Ironworks, Bradford (formerly the Shipley Tank Company, Limited).—A complete range of tanks, cylinders and drums which the firm manufactures is illustrated and described.

FREDK. E. POTTER, Limited, Imperial House, Kingsway, W.C. 2.—A pamphlet entitled "World Wide Publicity" has just been issued in celebration of twenty-five years in business of the above-mentioned firm.

JOSEPH KAYE AND SONS, Limited, 93, High Holborn, W.C. 1, and Lock Works, Leeds.—A copy of Kaye's motor accessories price list has been received. Oil economisers, pumps, seamless serrated oilcans and many other accessories are illustrated and described.

WATTS BROTHERS (Sheffield), Limited, Triumph Works, Keeton's-hill, Sheffield.—A copy of the firm's new catalogue on woodworking machinery. Besides descriptions of all the machines manufactured by the firm, illustrations of many machines are included.

JAMES WILEY AND SONS, Limited, Eagle Works, Darlaston.—A copy of a new list M6, which gives, besides illustrations of bolts, nuts, rivets and washers, the weights and various sizes and shapes of bolts. A leaflet describing the "Mojack," the jack with the crank shaft lift.

THE WELLMAN SMITH OWEN ENGINEERING CORPORATION, Limited, 36-38, Kingsway, W.C. 2.—A copy of Section III., catalogue on W.S.O. ingot handling machines. Part I. is taken up with combined vertical ingot stripping and charging machines, Part II. vertical ingot chargers, and Part III. guided strippers and stripping attachments. The machines are fully illustrated and the drawings are reproduced to represent blue prints.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, Limited, Trafford Park, Manchester.—Two new pamphlets have just been issued by this firm. "Power in the Textile Mill" is the title of one. Many illustrations have been embodied in this pamphlet, in addition to the descriptive matter. The number of this publication is 7874/2. In No. 7840/2 the electrical drive and control of machine tools has been described. The pamphlet is the outcome of a very careful investigation which the firm has carried out regarding the individual electrical drive and control of machine tools.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	25/-
(1) Spanish	25/-
(1) N. African	25/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	27/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(3) SCOTLAND—		
Hematite	5 5 0	—
No. 1 Foundry	4 18 6	—
No. 3 ,,	4 13 6	—
N.E. COAST—		
Hematite Mixed Nos.	4 15 0	4 15 0
No. 1	4 16 0	4 16 0
Cleveland—		
No. 1	4 15 0	4 15 0
Silicious Iron	4 15 0	4 15 0
No. 3 G.M.B.	4 10 0	4 10 0
No. 4 Foundry	4 7 6	4 7 6
No. 4 Forge	4 5 0	4 5 0
Mottled	4 0 0	4 0 0
White	4 0 0	4 0 0
MIDLANDS.		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
Part Mine Forge	*None offering.*	
North Staffs. No. 3 F'dry	4 5 0 to 4 10 0	
(3) Northampton—		
Foundry Nos. 2 and 1	*Nominal.*	
,, No. 3	4 0 0	—
,, Forge	3 10 0 to 3 12 6	
(3) Derbyshire—		
No. 3 Foundry	4 2 6 to 4 5 0	
Forge	3 12 6 to 3 15 0	
(3) Lincolnshire—		
Basic	4 0 0 to 4 5 0	
Foundry	4 5 0 to 4 10 0	
Forge	4 2 6 to 4 5 0	
(4) N.W. COAST—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	5 15 0	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	11 0 0	10 15 0
Best ,,	12 0 0	—
N.E. COAST—		
Crown Bars	12 0 0	—
Tees	14 10 0	—
LANCS.—		
Crown Bars	11 10 0	—
Second Quality Bars	10 5 0	—
Hoops	14 0 0	13 15 0
S. YORKS.—		
Crown Bars	12 0 0	—
Best ,,	13 0 0	—
Hoops	14 0 0	—
MIDLANDS—		
Marked Bars (Staffs.)	13 10 0	—
Crown Bars	11 10 0	—
Nut and Bolt Bars	10 5 0	—
Gas Tube Strip	11 10 0 to 11 15 0	
Hoops (*Nom.*)	14 0 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	14 0 0	—
Ship Plates ⅜in. and up	10 10 0	—
Sections	10 0 0	—
Steel Sheets ¼in. to ⅜in.	11 15 0	—
Sheets (Gal. Cor. 24 B.G.)	—	16 5 0

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	10 10 0	—
Angles	10 0 0	—
Boiler Plates	14 10 0	—
Joists	10 10 0	—
Heavy Rails	9 10 0	—
Fish-plates	14 10 0	—
Channels	14 10 0	—
Hard Billets	8 15 0	—
Soft Billets	7 15 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 10 0	—
Light ,,	11 0 0 to 13 0 0	
Billets	9 5 0	—
Ship Plates	10 10 0	—
Boiler ,,	14 10 0	—
MANCHESTER—		
Bars (Round)	10 0 0 to 12 0 0	
,, (others)	11 0 0 to 12 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	12 5 0	12 0 0
Plates	£10 to 12	10 0 0
,, (Lancs. Boiler)	16 0 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0 to 11 0 0	
Bessemer Billets	12 10 0	—
Hard Basic	9 5 0 to 9 10 0	
Soft ,,	7 15 0	—
Hoops	12 5 0	—
Soft Wire Rods	11 0 0	—
MIDLANDS—		
Small Rolled Bars	9 5 0 to 9 10 0	
Bessemer Billets	7 12 6	—
Hoops	11 15 0 to 12 0 0	
Gas Tube Strip	10 5 0 to 10 10 0	
Sheets (24 W.G.)	12 10 0	—
Galv. Sheets (f.o.b. L'pool)	16 0 0 to 16 10 0	
Angles	10 0 0	—
Joists	10 10 0	—
Tees	11 0 0	—
Bridge and Tank Plates	10 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/6 to 19/9
Block Tin (cash)	152 2 6
,, (three months)	153 10 0
Copper (cash)	62 12 6
,, (three months)	63 0 0
Spanish Lead (cash)	25 2 6
,, (three months)	23 11 3
Spelter (cash)	28 2 6
,, (three months)	27 17 6
MANCHESTER—	
Copper, Best Selected Ingots	69 0 0
,, Electrolytic	71 0 0
,, Strong Sheets	92 0 0
,, Loco Tubes	0 1 1¼
Brass Loco Tubes	0 0 11¾
,, Condenser	0 1 2¼
Lead, English	26 10 0
,, Foreign	25 7 6

FERRO ALLOYS.

(*All prices now nominal*).

	Per Ton.	Per Unit
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£27	10/-
,, 6 p.c. to 8 p.c. ,,	£25 10 0	9/-
,, 8 p.c. to 10 p.c. ,,	£24 10 0	8/-
,, Specially Refined		
Max. 2 p.c. carbon	£65	26/-
,, 1 p.c. ,,	£80	30/-
,, 0·75 p.c. carbon	£90	37/-
,, carbon free	1/10 per lb.	
Metallic Chromium	5/3 per lb.	
Ferro Manganese	(per ton) £15 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£13 0 0 scale 5/- per unit	
,, ,, 75 p.c.	£24 10 0 scale 6/- per unit	
,, Vanadium	18/- per lb.	
,, Molybdenum	6/6 per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£180	
Cobalt	12/- per lb.	
Aluminium (per ton)	£110 to £120 (British Official).	

FUELS.

	SCOTLAND.	Export.
LANARKSHIRE—		
(f.o.b. Glasgow)—Steam		20/-
,, ,, Ell		20/-
,, ,, Splint		21/- to 23/-
,, ,, Trebles		19.6
,, ,, Doubles		18/-
,, ,, Singles		17,6
AYRSHIRE—		
(f.o.b. Ports)—Steam		20/-
,, ,, Splint		21/-
,, ,, Trebles		19,6
FIFESHIRE—		
(f.o.b. Methil or Burntisland)—Steam		18/- to 22/-
Screened Navigation		26 6
Trebles		19/9
Doubles		18/9
Singles		18 6
LOTHIANS—		
(f.o.b. Leith)—Best Steam		19/9
Secondary Steam		19/3
Trebles		19/9
Doubles		18/9
Singles		18 3
	ENGLAND.	
(3) N.W. COAST—		
Steams		33/-
Household		40/- to 55/-
Coke		34/-
NORTHUMBERLAND—		
Best Steams		22/6 to 24/-
Second Steams		20/6 to 21/6
Steam Smalls		13/- to 15/-
Unscreened		20/6
Household		25/- to 30/-
DURHAM—		
Best Gas		22/6 to 23/-
Second		20/- to 21,6
Household		25/- to 30/-
Foundry Coke		32/6 to 35/-
SHEFFIELD—	INLAND.	
S. Yorks. Best Steam Hards	23/- to 25/-	—
Derbyshire Hards	20/- to 21/-	—
Seconds	19/- to 20/-	—
Cobbles	19/- to 20/-	—
Nuts	18/- to 19/-	—
Washed Smalls	11/- to 12/-	—
Best Hard Slacks	12/- to 13/-	—
Seconds ,,	10/- to 11/-	—
Soft Nutty ,,	7/6 to 8,6	—
Pea ,,	7/- to 8/-	—
Small ,,	2/- to 4 6	—
House, Branch	36/- to 37/6	—
,, Best Silkstone	34/- to 36/-	—
Blast Furnace Coke (Inland and Export)	19/- to 21/-	

CARDIFF— (9) SOUTH WALES.	
Steam Coals:	
Best Smokeless Large	27/3 to 27/6
Second ,, ,,	26/9 to 27/3
Best Dry Large	26/6 to 27/-
Ordinary Dry Large	24/- to 25/-
Best Black Vein Large	26/9 to 27/3
Western Valley ,,	26/3 to 26/9
Best Eastern Valley Large	26/3 to 26/9
Ordinary ,, ,,	24/- to 25/-
Best Steam Smalls	18/6 to 19/-
Ordinary ,,	15/- to 18/-
Washed Nuts	22,6 to 25/-
No. 3 Rhondda Large	28/- to 29/-
,, ,, Smalls	19/6 to 20/-
No. 2 ,, Large	23/- to 24/-
,, ,, Through	19/- to 20/-
,, ,, Smalls	15/- to 16/-
Coke (export)	34/- to 35/-
Patent Fuel	25,6 to 28,6
Pitwood (ex ship)	28 6 to 29 6
SWANSEA—	
Anthracite Coals:	
Best Large	47,6 to 50/-
Seconds	42,6 to 45/-
Red Vein	32 6 to 35/-
Big Vein	42,6 to 47,6
Machine-made Cobbles	52/6 to 55/-
Nuts	52/6 to 55/-
Beans	42,6 to 45/-
Peas	24/- to 26/-
Breaker Duff	8/- to 8/6
Rubbly Culm	16 6 to 17/-
Steam Coals:	
Large	22/6 to 24/6
Seconds	20/- to 22/6
Smalls	14/- to 16/-
Cargo Through	18/- to 20 -

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

French Engineering Notes.

(From our Correspondent in Paris.)

Productive Costs.

THERE have been several meetings lately between representatives of iron and steel firms and of the engineering industries to discuss the ways and means of coming to an agreement over the question of manufacturing costs. Pig iron producers and rolled iron and steel firms have long complained that their situation is being jeopardised by the growing importation of foreign material, and, on the other hand, home consumers refuse to accept any advance in import duties which would have the effect of increasing the cost of raw material on the French market, merely to permit of pig iron and other firms selling their products at lower prices abroad. Now that manufacturers are finding that the home demand is not sufficient to absorb their production they are equally anxious to build up a foreign trade, and the question now being discussed is the possibility of reconciling the interests of both. At first it was stated that the Customs Commission had refused to give in to the demands of the pig iron producers, but it is now reported that the Commission has recommended that the coefficient should be increased to 2.5 for hematites and spiegel iron and reduced to 1.8 for other pigs, the existing coefficient for all kinds of raw iron being 2. At the time the present coefficient was established it represented an *ad valorem* duty of 6 per cent., and under the new arrangement, whereby imports are assessed at their actual value c.i.f., and taking into account the prices now ruling, the proposed coefficient represents 12 per cent. While this has helped to increase the values of raw material in France, consumers are looking in other directions for means to bring down manufacturing costs sufficiently to permit of their doing an export trade, and while the meetings with pig iron producers have turned more particularly upon proposals to secure further reductions in the cost of transporting raw material, it is suggested that negotiations should be entered into with constructive engineers abroad with a view of seeing if it is possible to find some basis for common action. The world's markets are so restricted that any indiscriminate competition could not fail to have disastrous results, and it would be better for all concerned to adopt a policy of participation, such as was attempted recently in the case of rolled iron and steel makers, when the negotiations fell through on account of the attitude of certain Belgian firms.

Port of Marseilles.

The Marseilles Chamber of Commerce is carrying out a particularly ambitious programme in view of the considerable development of traffic which is expected to take place with the future navigation of the Rhone, that will provide an uninterrupted waterway from the Rhine, with its vast network of canals. At the same time, the opening up of the Colonies is already bringing fresh traffic to Marseilles, and it is hoped eventually that the colonial trade will contribute considerably to the shipping activity. However great may be this activity, Marseilles will be able to cope with everything by the extension of the port to the Etang de Berre, which will provide safe and ample anchorage for shipping discharging and embarking goods in transit by the Rhone, while the passage of the Caronte from the sea to the Etang de Berre, between Port de Bouc and Martigues, will be lined with wharves to be constructed and equipped for dealing with any amount of traffic. A good deal of work has already been done at Port de Bouc, which can now take vessels drawing 7 m.—say, 23ft.—of water. Along the Caronte 4 kiloms. of wharves are under construction, and in view of the facilities to be offered, a number of factories is being erected in the proximity. Within four years it is expected that vessels of 10,000 tons will be able to draw up alongside the wharves or go into the Etang de Berre. When completed the facilities offered for shipping between Port de Bouc and Martigues will be greater than those of Marseilles itself.

Air Railways.

The idea of constructing an overhead mono-rail line which will combine the velocity of aircraft with the security of the railway was presented ten years ago to the Ministry of Public Works, when it was declared that the invention was sufficiently interesting to be worked out experimentally. It was not until 1914 that arrangements were definitely made for carrying out tests, which were, however, abandoned on the outbreak of hostilities. The system consists simply of an aerial line carried on standards, from the line being suspended a streamline form of car with engine and propeller, in many respects similar to the cars on the German dirigibles. The claim put forward is that, with the powerful engines and the high propeller efficiency now available, it will be possible to attain extremely high speeds, while the line from which the car is suspended offers a perfectly safe guide. It is claimed that a speed of 150 miles an hour is quite feasible, while the cost of the installation would be comparatively small. After the Armistice the matter was again taken up by the Minister of Public Works, who appointed a commission to report upon the invention, and as the conclusions point to the desirability of carrying out tests, the Government is providing the inventor with everything necessary for laying down an experimental line in the neighbourhood of Péronne. The Municipal Council is also investigating the matter with the idea of eventually installing a line between Paris and St. Germain, if experiments should prove that the system is perfectly satisfactory. Incidentally, I may state that the high degree of efficiency obtained with propellers nowadays was exemplified in tests carried out on a cycle track last week by one of the competitors in the forthcoming competition of gliders. Lying full length on a frame on two bicycle wheels, he rotated a propeller at the rear with pedals and attained a speed of 30 miles an hour. The conclusion come to by experts who witnessed the experiment is that it is quite possible for a man to propel himself with a plane.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

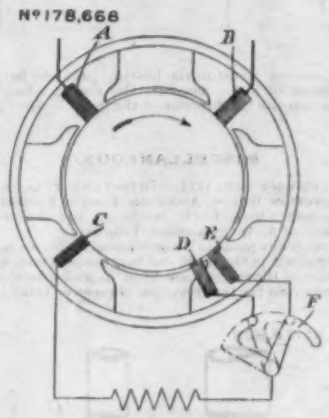
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

178,668. May 9th, 1921.—IMPROVEMENTS IN SELF-REGULATING DYNAMO-ELECTRIC MACHINES, William Holt and Brolt, Limited, both of Road End-road, Oldbury.

THIS invention relates to variable-speed self-regulating dynamos for the electric lighting of road vehicles, and more especially dynamos used on motor omnibuses, which require machines which will give several charging rates or peak outputs according to circumstances. A maximum charging rate may, for example, be required at night when all the lamps are in service, whilst a

No 178,668



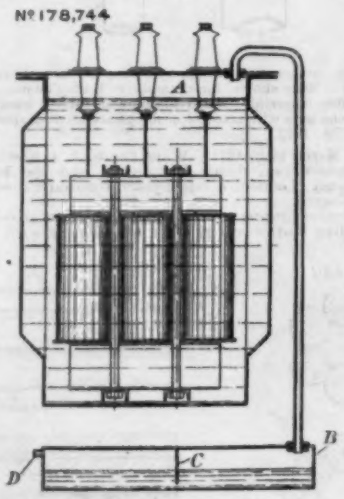
lower output is required for charging the cells during the day. One method of carrying out the invention is shown in the drawing, where, in addition to the two main brushes A and B, there are three other brushes C D E. One end of the field winding is connected to the brush C, whilst the other end may be connected to the brush D or E by means of a switch F, so that the voltage applied to the field winding can be altered according to the output required.—*April 27th*, 1922.

TRANSFORMERS.

178,744. May 23rd, 1921.—IMPROVEMENTS IN OR RELATING TO OIL TANKS FOR ELECTRICAL APPARATUS, Filiberto Gotta, of Via Cernaia, 15, Turin, Italy.

The object of this invention is to prevent oxidation of the oil in transformers, and the object is attained by preventing the renewal of the air in contact with the surface of the oil. The air space A is connected by means of a pipe with a vessel B provided with a partition C and being partially filled with oil as shown. When the oil below the space A in the transformer tank is heated

No 178,744



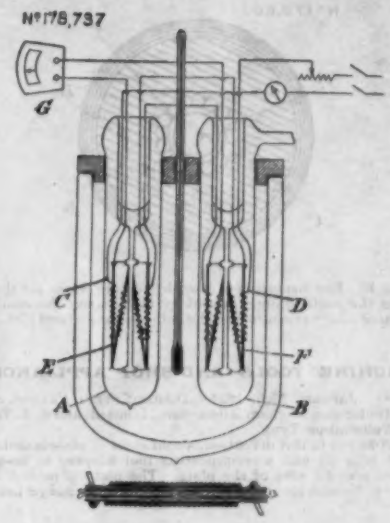
it expands and air is forced into the lower vessel B. The oil level in the right-hand compartment of this vessel is reduced, whilst that in the other compartment is increased, and air passes out of this compartment by way of the pipe D. The air in the space A, however, is never changed, and as the air pressure in the main tank never attains a high value, air does not leak through the joints and fresh air is not drawn into the tank when the oil cools.—*April 27th*, 1922.

MEASURING AND TESTING INSTRUMENTS.

178,737. May 11th, 1921.—THERMO-COUPLE MANOMETERS, Kazuo Kambayashi, No. 47, Uji-cho, Kuze-gun, Kyoto, Japan.

This manometer, which is intended for measuring low vacua, depends for its action on the variation in the temperature rise of an electrically heated wire caused by the degree of attenuation in the surrounding atmosphere. The temperature of the wire is determined by a thermo-couple. The instrument comprises two bulbs A and B, of which A is evacuated and sealed up. B has a branch for connection with the vacuum to be measured. In each bulb there is a set of coiled wires C and D, the temperature of which may be measured by thermo-couples E and F. The whole device is immersed in a liquid of constant temperature. The wire coils C D are connected in series and supplied with current from any convenient source. The thermo-couples are connected in opposition, and a milli-voltmeter G is included in the circuit. When the vacua in the two bulbs A and B are the

No 178,737

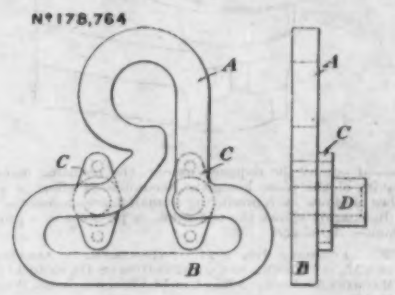


same, G is not deflected, while a rise or fall in the vacuum in B, as compared with that in A, produces positive or negative indications on the voltmeter.—*April 27th*, 1922.

178,764. April 27th, 1922.—IMPROVEMENTS RELATING TO ELECTRICAL MEASURING AND INDICATING INSTRUMENTS, Ralph Henry Barbour, the Electrical Apparatus Company, of Vauxhall Works, South Lambeth-road, London, S.W. 8, and Arthur John Martin, of the same address.

This invention relates to electrical instruments, such as moving coil ammeters, in which a conductor is used for carrying the current which produces the operative magnetic field. When the main current is larger than is requisite for producing this field a shunt may be employed. Hitherto a separate shunt has

No 178,764



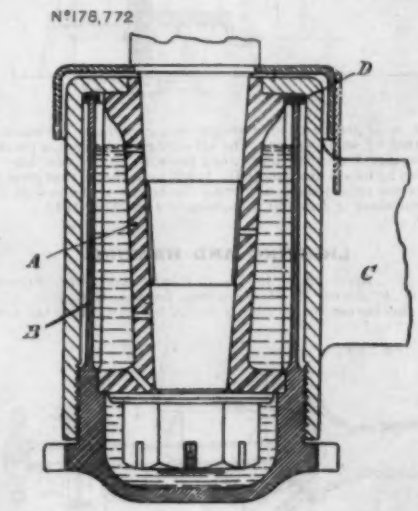
been employed, but according to this invention the conductor and shunt form a single piece. In the drawing the conductor is shown at A and the shunt at B, and two terminals C are provided at the rear of the casting for leading the current in and out in any suitable manner, such, for example, by means of sockets D.—*April 27th*, 1922.

MOTOR CARS AND ROAD TRAFFIC.

178,772. March 10th, 1921.—OIL-LUBRICATED PIVOT BEARINGS, W. L. Spence, 44, Ormidale-terrace, Murrayfield, Edinburgh.

The inventor aims to lubricate the pivot bearings of the steering wheels on motor vehicles by surrounding them with an oil

No 178,772



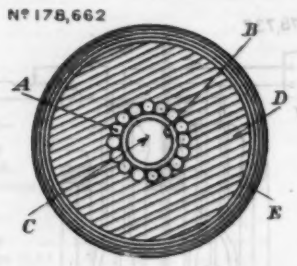
bath. The bush A, in which the pivot works, is spigoted into a cup B, which, in turn, is screwed into the end of the axle C. The cup is filled with oil and a tight joint is made at D, so that the oil cannot escape.—*April 27th*, 1922.

TRANSMISSION OF POWER.

178,662. May 3rd, 1921.—IMPROVEMENTS IN CABLES FOR CONVEYING ENERGY, Lovell Newton Reddie, of 1, Furnival-street, Holborn, E.C. 4.

The conductor of the cable described in this specification is composed of copper strands A, which are rolled in one or more

layers upon a cylindrical helix B of small diameter composed of wire and forming a cylindrical space C within it. Upon the conductors, paper D, textile material or any other insulating material is placed, and it is then covered by the protecting sheath

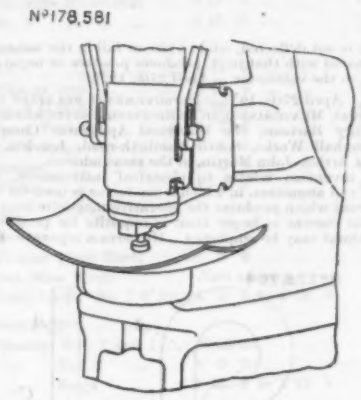


of lead E. The insulation is dried by forcing warm air through it, and the cable is impregnated by introducing the insulating substance under pressure into the hollow core.—*April 27th*, 1922.

MACHINE TOOLS AND SHOP APPLIANCES.

178,581. January 25th, 1921.—DISHING STEEL PLATES, Swan, Hunter and Wigham Richardson, Limited, and S. J. Taylor, Wallsend-on-Tyne.

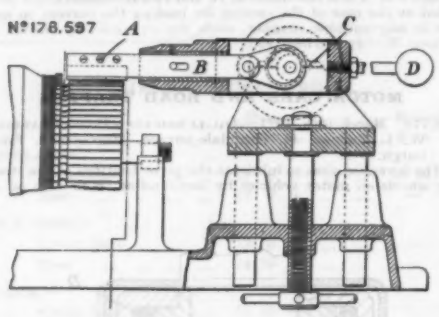
ACCORDING to this invention, a cold sheet or plate is dished by means of a die and a reciprocating tool adapted to co-act to depress a small area of the plate. The plate is moved about between die and tool until the whole area to be dished has been



depressed out to the required extent, the resulting dishing or concavity of the plate being the accumulated effect of a large number of blows, each producing a small depression in the plate. The illustration shows the operation in progress in a punching machine.—*April 25th*, 1922.

178,597. February 1st, 1921.—IMPROVEMENTS RELATING TO THE MANUFACTURE OF COMMUTATORS OF DYNAMO-ELECTRIC MACHINERY, Leonard Nical, of 14, Clifton-avenue, Wembley, Middlesex.

The device described in this specification is for cutting away the mica between commutator segments. A piece of a saw

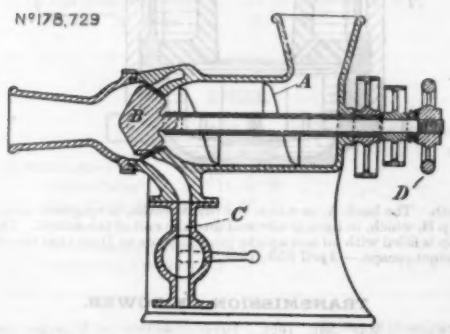


blade A is attached to a reciprocating plunger B, which is operated by an excentric. The actuating mechanism is pivoted in bearings C and the downward pressure on the saw may be applied by means of a handle D. It will be gathered that arrangements are provided for adjusting the height of the saw to suit commutators of different diameters.—*April 27th*, 1922.

LIGHTING AND HEATING.

178,729. April 29th, 1921.—A POWDERED FUEL BURNER, *W. E. Evans*, 27, *Chancery-lane, London, W.C. 2.*

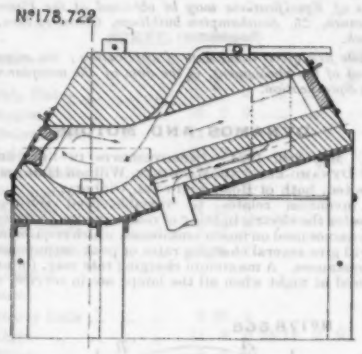
In this burner the powdered coal is fed forward by the screw



conveyor A to the conical mixer B, where it meets a supply of compressed air from C. The fuel is ground up by the mixer and projected into the furnace by the air. Separate drives are provided for the mixer and the conveyor, while an adjustment D allows the size of the passage past the mixing cone to be regulated.—*April 27th*, 1922.

178,722. April 22nd, 1921.—GAS-FIRED FURNACES, South Metropolitan Gas Company, and D. Chandler, 709, Old Kent-road, London, S.E. 15.

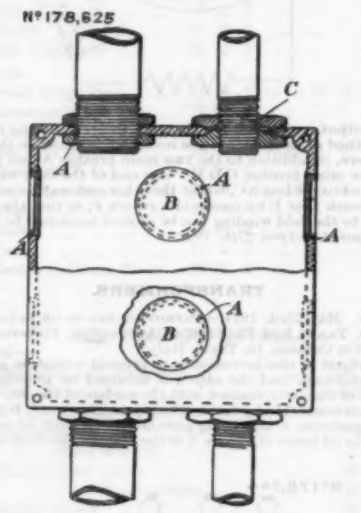
In this gas-fired furnace the gas and air for combustion are supplied by a duct in the roof of the furnace, and after impinging on the molten metal in the hearth, circulate back and escape by means of a flue beneath the sloping charging floor. The arrows indicate the direction of the gases.—*April 27th*, 1922.



MISCELLANEOUS.

178,625. February 12th, 1921.—IMPROVEMENTS IN OR RELATING TO JUNCTION BOXES, Alexander Penden Rutherford, of 9, Summerside-place, Leith, Scotland, and Andrew Nisbet Haddow, of 3, Antigua-street, Edinburgh.

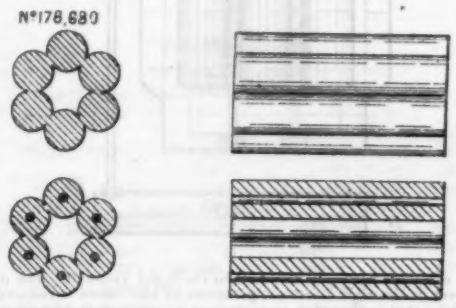
The junction box made in accordance with this invention has a number of holes A in the sides, end, and bottom, and, with one or two exceptions, these holes are filled in with plugs, which can easily be removed for the reception of pipes or tubes, which are



preferably connected to the box by means of lock-nuts as shown. The plugs or discs shown, for example, at B may be made of any compressible material. When the pipe or tube is smaller than the holes the nuts with a spigot or flange are used, as shown at C. —*April 27th*, 1922.

178,680. March 18th, 1921.—WALL PLUGS, J. J. Rawlings, 95, Gloucester-road, South Kensington, and the Rawlplug Company, Limited, Lenthall-place, Gloucester-road, South Kensington.

The inventor proposes to use a plug of the form shown, made by extruding lead or a lead alloy, for plugging walls to take



fastenings. It is suggested that the plug may be strengthened by hard wire cores as shown in the lower illustration.—*April 27th*, 1922.

IT seems to be thought in some quarters that, if certain of the canals are turned into roads, they should be used for high-speed motor traffic. The *Autocar* is of opinion, however, that, should the conversion take place, the new road thus brought into being would be of greater value for heavy rather than for light vehicles. Unquestionably it is the heavy motor transport that destroys a normal roads surface, and the more the heavy brigade are furnished with suitably constructed thoroughfares, reserved exclusively for themselves, the better for the general road communications throughout the country. At present, however, with the prevailing shortage of funds, there is not much prospect of an early conversion of any canals into roads.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

DIESEL ENGINE USERS' ASSOCIATION.—Institution of Electrical Engineers, Victoria Embankment. Paper, "Marine Diesel Engines," by Mr. H. F. P. Purday, B.Sc. Non-members desirous of attending the meeting can make application for tickets of admission to the hon. secretary at 19, Cadogan-gardens, S.W. 3.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Discourse, "Gilbert and Sullivan," by the Hon. Maurice Baring. 9 p.m.

SATURDAY, JUNE 3RD.

ROYAL AERONAUTICAL SOCIETY.—Visit to the National Physical Laboratory, Teddington. Meet at the booking-office, Waterloo (L. and S.W.). 9.15 a.m.

WEDNESDAY, JUNE 7TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, W.C. 2. Wireless Section meeting. "The Performance of a Radio-telegraphic Transmitter, with Special Reference to the New Installation at North Foreland," by Mr. N. Lea, B.Sc.; "A Dynamic Model of Tuned Electrical Circuits," by Professor C. F. Jenkin, M.A. 6 p.m.

THURSDAY, JUNE 8TH.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.—9 Conduit-street, W. 1. Lecture, "What is Architectural Design?" by Mr. D. S. Maccoll, M.A. 5 p.m.

FRIDAY, JUNE 9TH.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Discourse, "Physiological Effects at High Altitudes in Peru," by Mr. Joseph Barcroft. 9 p.m.

SATURDAY, JUNE 10TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Eastern District meeting. Members will assemble on Parkeston Quay railway platform. 11.30 a.m.

MONDAY, JUNE 12TH, TO TUESDAY, JUNE 20TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Summer Meeting in Paris and Liége.

MONDAY, JUNE 12TH.

THE SOCIETY OF ENGINEERS.—Geological Society, Burlington House, Piccadilly, W. 1. Two papers on "The Physical Properties of Clay," by Dr. H. Chatley, D.Sc., and Mr. A. S. E. Ackermann, B.Sc. 5.30 p.m.

TUESDAY, JUNE 13TH.

IRON AND STEEL INSTITUTE.—Mappin Hall, Sheffield University. Adjourned meeting at Sheffield. Continued discussion on "British Siemens Furnace Practice," by Mr. Fred Clements. 3 p.m.

THURSDAY, JUNE 15TH.

ROYAL AERONAUTICAL SOCIETY.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Annual Wilbur Wright lecture. Paper, "Some Aspects of Aeronautical Research," by Lieut.-Colonel A. Ogilvie. 5.30 p.m.

MONDAY TO WEDNESDAY, JUNE 19TH TO 21ST.

INSTITUTE OF COST AND WORKS ACCOUNTANTS.—Sessional examinations will be held in London, Manchester, Birmingham, Sheffield, Glasgow and Bristol.

TUESDAY TO THURSDAY, JUNE 20TH TO 22ND.

INSTITUTION OF MINING ENGINEERS.—Seventy-seventh general meeting at Sheffield. For programme see page 573.

THURSDAY, JUNE 29TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—Natural History Museum, S.W. Annual conversazione. 8.30 to 11 p.m.

WEDNESDAY TO SATURDAY, JUNE 21ST TO 24TH.

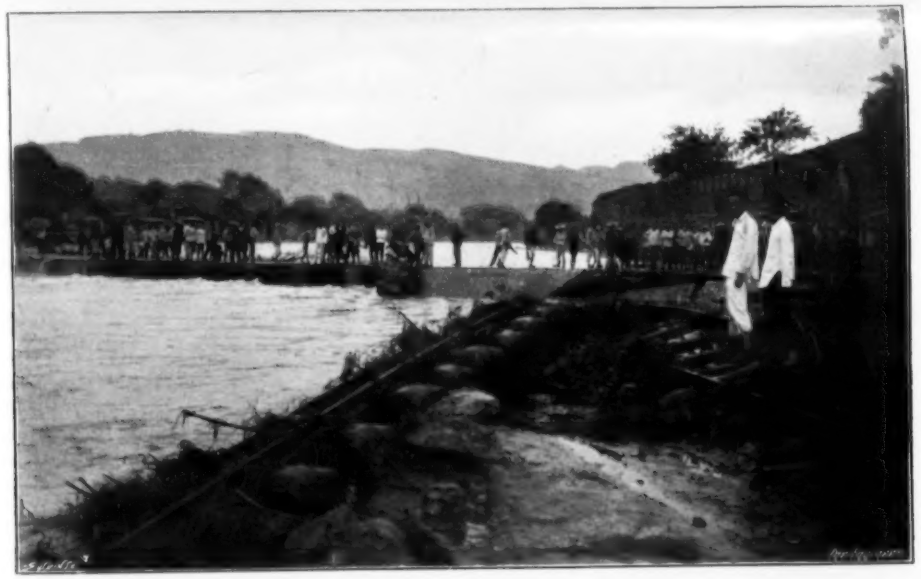
INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Annual general meeting and conference at Cardiff. For programme see page 570.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—The Council of the Institution of Electrical Engineers has made the following award of premiums for papers read during the session 1921–22 or accepted for publication:—The Institution Premium to Mr. J. G. Hill; Ayrton Premium to Mr. L. H. A. Carr; Duddell Premium to Mr. T. L. Eckersley; Fahie Premium to Mr. E. S. Byng; John Hopkinson Premium to Mr. F. P. Whitaker; Kelvin Premium to Mr. R. Torikai; Paris Premium to Mr. J. A. Kuyser; extra premiums to Mr. J. Anderson, Mr. F. J. Teago, Mr. W. Wilson; Wireless Premiums to Mr. E. B. Moullin and Mr. L. B. Turner, Mr. C. S. Franklin; Willans Premium awarded triennially alternately by the Institution and the Institution of Mechanical Engineers, to Mr. K. Baumann.

INSTITUTE OF PHYSICS.—At the annual general meeting of the Institute of Physics, held on May 23rd in the rooms of the Royal Society, the following offices and board were elected to serve for the year beginning October 1st, 1922:—President: Sir J. J. Thomson, O.M. Past-president, Sir R. T. Glazebrook, K.C.B. Vice-presidents, Sir Charles Parsons, K.C.B., Professor W. Eccles, Professor C. H. Lees, Mr. C. C. Paterson. Non-official members of board, Dr. R. S. Clay, Professor C. L. Fortescue, Professor A. Gray, Major E. O. Henrici, Sir J. E. Petavel, K.B.E., Dr. E. H. Rayner, Sir Napier Shaw, K.B.E., and Mr. R. S. Whipple. Representatives of participating societies: Physical Society, Mr. C. E. S. Phillips, Mr. R. E. Smith; Faraday Society, Mr. W. R. Cooper; Optical Society, Mr. John Guild; Rontgen Society, Dr. G. W. C. Kaye; Royal Microscopical Society, Mr. J. E. Barnard. The annual report stated that there were 408 members of the Institute at the end of the year, of whom 258 were Fellows. In the course of his presidential address Sir J. J. Thomson, after dealing with the project to establish a *Journal* of scientific instruments, spoke of the present depression in industry, but he made the reassuring statement that out of sixty-seven students who graduated with distinction in physics and chemistry in 1921, forty-six had obtained positions, while fourteen were doing research work. He hoped that the series of lectures on "Physics in Industry," which had been established, would act to some extent as "refresher courses." Speaking of the difficulties which the Safeguarding of Industries Act had in many instances placed in the way of research, he characterised research as a "key industry," and he hoped that the Government would put every facility in the way of research workers being able to obtain without delay the apparatus they required.

THE FLOOD PROBLEM IN CHINA

FIGS. 11 AND 12—FLOOD EFFECTS IN THE PO SHAN AREA, SUMMER, 1921



FIGS. 15 AND 16—DESTRUCTION OF BRANCH OF SHANTUNG RAILWAY

FIGS. 17 AND 18—HOUSES ON THE POINT OF COLLAPSE AS RESULT OF FLOOD